Grizzly Bear Harvest Management in British Columbia: Background Report

A.N. (Tony) Hamilton
M.A. (Matt) Austin
Biodiversity Branch
Ministry of Water, Land and Air Protection
Victoria, BC

Introduction

The British Columbia Grizzly Bear Science Panel was appointed by the provincial government in July 2001 to review the Ministry of Water, Land and Air Protection's current grizzly bear population estimation procedure and harvest management system. This report was drafted to provide the panel detailed information about the population estimation and harvest management methods and their application in BC. An earlier draft was given to panel members in October 2001 as background information. This revised version contains more historical information and a full references cited list.

Prehistorical and Historical Background

Current grizzly bear (*Ursus arctos*) populations in British Columbia originate from common ancestors that migrated southward from the Yukon approximately 11-12,000 years ago. There is no strong evidence to suggest that grizzlies recolonized British Columbia from glacial refugia within the province, from Alaska's Alexander Archipelago, or from the south.[1] Phylogenetic analysis using mitochondrial DNA indicates that British Columbia's grizzly bears originate from two maternal lines that separated prior to colonizing North America (Waits et al. 1998) but cohabitated Beringia (Leonard et al. 2000). Neither of the British Columbia clades are closely related to the brown bears on Admiralty, Baranof and Chichigof islands in nearby SE Alaska (Talbot and Shields 1996).

There is strong evidence for human-caused population isolation and recent loss of genetic diversity for grizzly bear populations within the province (Patkeau et al. 1998, Ross 2002, Proctor et al. 2002). The exact distribution of the clades described by Waits et al. (1998) is unknown.

At one time, all of British Columbia was covered in glacial ice, except for a few coastal refugia and the highest mountain peaks. The maximum extent of the Fraser glaciation in British Columbia was 14,000 years ago (Clague 1989). The first area to re-vegetate was at the intersection of the western Cordilleran and the eastern Laurentide ice sheets on the western margins of the Interior Plains in the NE corner of the province. Tundra vegetation attracted the grazing ungulates from Beringia and their human predators were not far behind (Fladmark 1986). Grizzly bears were part of that migration, eventually populating much of western North

[1] Byun et al. (1997) provide evidence that black bears (*Ursus americanus*) recolonized coastal BC after the Wisconsin from a glacier-free refugium that linked Haida Gwaii, Vancouver Island and the nearby BC mainland. Another maternal line recolonized the rest of mainland BC from south of the province. Both clades now overlap. Several unusually large black bear skeletons found in the Windy Link Caves near Gold River on Vancouver Island were dated to 9,800 years ago (Nagorsen et al. 1995) also suggesting coastal recolonization from a coastal refugia.

America and northern Mexico. A partial skull of *Ursus arctos* was found at nearby Whidbey Island (Washington State) that dates from 9000 years BP (Mustoe and Carlstad 1995), but no fossil specimens have been located in British Columbia.

British Columbia has experienced gradual warming and cooling trends in the last 10,000 years, including the Little Ice Age from 1350-1870 A.D. (Pielou 1991). The majority of tree species distribution and ecosystem patterns developed 7000 to 4000 years ago (Hebda 1996). A variety of climatic and geological influences and recolonization from geographic and elevational refugia created the huge diversity of forested and non-forested ecosystems that are found in British Columbia today. Grizzly bears adapted to this wide diversity of landscapes and eventually occupied the entire province except Vancouver Island, the Queen Charlotte Islands and other smaller coastal islands. Physical isolation does not appear to have prevented colonization of the near coastal islands. Grizzly bears are excellent swimmers and a family group was seen on Hardwicke Island in 1999, less than three kilometers from Vancouver Island. The availability of spawning salmon aided grizzly bear dispersal and colonization of many areas of the province. In some cases, salmon carcass volumes were enormous. For example, gross available biomass in the Bella Coola River in mid-coastal British Columbia is estimated at over 3,000 tonnes annually (Hamilton, unpublished data). The availability of ungulates (neonates, adults, winter killed carcasses, wolf, cougar and black bear kills) and smaller prey such as beaver (*Castor canadensis*), marmots (*Marmota* spp.) and ground squirrels (*Spermophilus* spp.) also influenced grizzly bear distribution[2]. Such abundant prey supported higher bear densities than would otherwise be possible (Hilderbrand et al. 1999) and are critical to maintaining current abundance and distribution of the species.

Historic wildfires and other natural disturbances created a diverse mosaic of seral forests (Voller and Harrison 1998) and associated feeding opportunities. Abundant, productive, non-forested ecosystems in valley bottoms and subalpine habitats (e.g. fens, avalanche tracks, meadows) provided important seasonal plant forage. Insect colonies and nests were abundant and important food sources (ants, wasps and possibly estivating moths). Mature forests provided essential grizzly bear resources including berries under open (patchy) canopies, whitebark pine nuts cached by squirrels and raided by bears, and skunk cabbage found in the swamp forests of the coast and wet zones of the southern interior.

The richness and diversity of habitat opportunity in British Columbia resulted in some of the highest densities of the species on the continent. We estimate that there were over 20,000 grizzly bears in British Columbia prior to European contact (Table 1, Figure 1).

---

[2] The relatively recent range expansion and increased abundance of moose (*Alces alces*) in the southern part of the Central Interior and the Southern Interior Ecoprovinces (Spalding 1990) may have also influenced grizzly bear population productivity.

Table 1: Historic Grizzly Bear Population Estimate Based on Habitat Capability

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
1	14	195	319	5,690
1	15	159	264	5,561
2	1	29	45	721
2	2	34	54	975
2	3	40	62	1,036
2	4	91	134	1,791
2	5	100	163	2,933
2	6	71	110	2,327
2	7	27	45	918
2	8	164	264	4,564
2	9	48	76	1,612
2	10	37	56	1,087
2	11	82	130	2,899
2	12	116	183	3,051
2	13	65	107	2,467
2	14	53	88	2,199
2	15	73	119	2,487
2	16	13	18	387
2	17	42	64	1,021
2	18	75	112	1,760
2	19	39	61	965
3	12	31	64	2,480
3	13	41	70	2,399
3	14	41	63	1,082
3	15	57	92	1,990
3	16	62	110	3,006
3	17	22	50	2,697
3	18	16	36	1,995
3	19	20	43	2,047
3	20	8	19	1,664
3	26	38	79	2,064
3	27	17	38	1,632

Table 1 (cont.)

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
3	28	17	38	1,134
3	29	23	53	2,213
3	30	22	64	2,951
3	31	10	26	2,097
3	32	71	139	3,766
3	33	41	77	2,122
3	34	14	25	492
3	35	35	52	836
3	36	82	144	2,648
3	37	43	85	1,721
3	38	35	74	1,655
3	39	37	75	1,550
3	40	40	80	1,643
3	41	24	46	947
3	42	43	74	1,483
3	43	31	47	1,058
3	44	51	78	1,613
3	45	55	97	2,059
3	46	87	143	2,836
4	1	108	146	1,556
4	2	70	97	1,227
4	3	53	88	1,602
4	4	49	76	1,099
4	5	35	55	838
4	6	89	141	2,227
4	7	73	118	1,886
4	8	84	136	2,152
4	9	46	75	1,200
4	14	33	55	885
4	15	75	110	1,699
4	16	77	112	1,751

Table 1 (cont.)

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
4	17	84	118	1,657
4	18	61	88	1,370
4	19	49	71	1,394
4	20	129	193	3,799
4	21	52	76	1,314
4	22	107	155	2,366
4	23	195	270	3,301
4	24	92	126	1,836
4	25	147	203	3,116
4	26	119	170	3,077
4	27	46	66	1,439
4	28	26	37	746
4	29	33	47	798
4	30	58	82	1,271
4	31	69	96	1,250
4	32	128	182	2,451
4	33	86	122	2,145
4	34	134	199	3,855
4	35	121	168	2,607
4	36	160	225	3,892
4	37	67	94	1,945
4	38	180	244	3,651
4	39	129	175	2,394
4	40	70	103	2,209
5	1	14	51	2,257
5	2	118	323	13,613
5	3	25	75	3,640
5	4	71	210	7,812
5	5	64	161	5,859
5	6	83	181	5,111
5	7	207	328	6,126

Table 1 (cont.)

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
5	8	245	404	7,721
5	9	244	392	7,300
5	10	83	157	3,324
5	11	36	74	1,894
5	12	63	260	10,009
5	13	74	348	14,147
5	14	11	53	4,057
5	15	354	555	9,044
5	16	39	62	1,058
6	1	110	221	5,284
6	2	139	240	4,236
6	3	421	740	15,169
6	4	221	415	8,038
6	5	27	52	1,014
6	6	74	136	2,478
6	7	170	267	4,354
6	8	325	551	9,365
6	9	459	771	13,475
6	10	48	77	1,308
6	11	250	450	8,495
6	12	0	0	3,434
6	13	0	0	6,511
6	14	326	521	8,729
6	15	298	493	8,397
6	16	199	301	5,133
6	17	313	476	9,910
6	18	189	298	6,540
6	19	122	268	7,499
6	20	253	547	13,763
6	21	411	684	13,389
6	22	269	512	11,013

Table 1 (cont.)

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
6	23	216	446	10,808
6	24	165	364	9,240
6	25	299	663	15,537
6	26	435	805	16,580
6	27	96	205	4,971
6	28	38	94	3,048
6	29	178	305	5,883
6	30	301	447	6,680
7	1	40	65	2,140
7	2	88	136	3,086
7	3	111	170	3,760
7	4	60	97	2,382
7	5	120	182	2,955
7	6	74	122	1,990
7	7	85	158	2,941
7	8	31	73	1,911
7	9	25	63	1,731
7	10	8	39	1,531
7	11	14	51	1,843
7	12	82	195	5,087
7	13	34	91	2,662
7	14	8	40	1,611
7	15	13	57	2,220
7	16	97	188	3,715
7	17	103	168	2,704
7	18	114	197	3,745
7	19	122	210	4,326
7	20	60	149	4,337
7	21	176	327	6,661
7	22	157	254	4,154
7	23	169	273	4,323

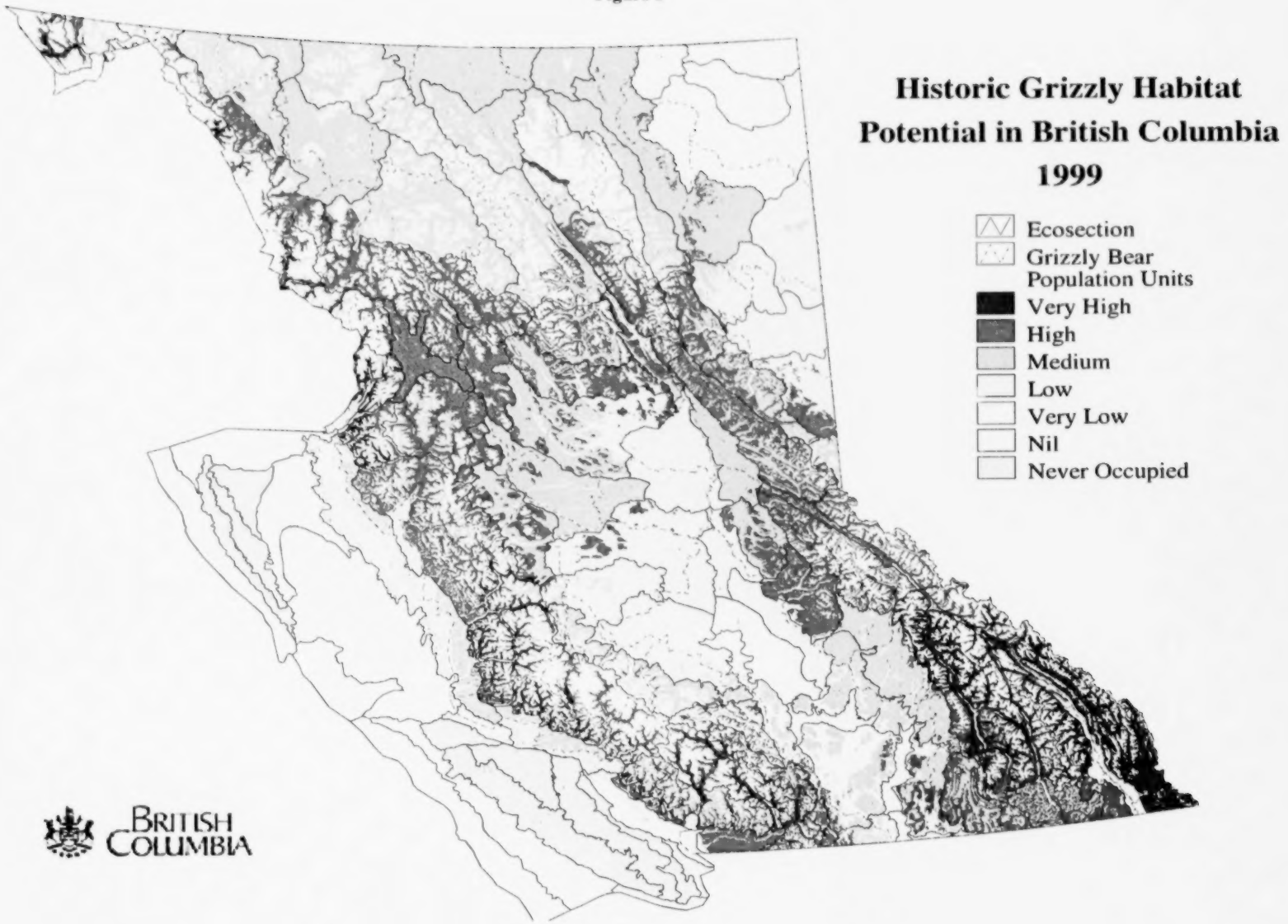
Table 1 (cont.)

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
7	24	37	135	4,836
7	25	47	133	4,051
7	26	58	129	3,200
7	27	171	298	5,313
7	28	214	379	7,470
7	29	121	195	3,241
7	30	87	136	2,167
7	31	191	307	5,351
7	32	19	91	3,628
7	33	29	142	5,691
7	34	8	37	1,499
7	35	29	78	2,354
7	36	102	158	3,095
7	37	176	274	6,041
7	38	379	613	12,674
7	39	132	279	8,649
7	40	148	274	7,378
7	41	202	344	7,756
7	42	107	228	5,975
7	43	91	149	3,032
7	44	30	81	2,361
7	45	86	222	6,194
7	46	38	162	6,111
7	47	99	261	9,821
7	48	136	256	6,983
7	49	161	324	10,934
7	50	106	222	6,705
7	51	286	583	18,156
7	52	305	654	17,305
7	53	241	484	9,829
7	54	171	344	7,400

Table 1 (cont.)

Region	Management Unit	Estimated Historic Number of Bears (~1800)		Useable Land Area km^2
		Minimum	Maximum	
7	55	23	96	17,767
7	56	19	88	15,703
7	57	42	91	2,515
7	58	27	46	785
8	1	14	28	1225
8	2	2	6	463
8	3	21	46	1,310
8	4	19	35	1,033
8	5	56	94	2,318
8	6	11	24	993
8	7	18	38	1,055
8	8	18	38	1,752
8	9	18	33	900
8	10	33	61	1,448
8	11	13	25	757
8	12	66	115	2,217
8	13	19	33	566
8	14	76	132	2,520
8	15	101	165	2,783
8	21	14	25	614
8	22	6	14	673
8	23	69	124	2,552
8	24	31	62	1,261
8	25	19	39	844
8	26	10	25	795
Total		**20,427**	**36,827**	**861,455**

Figure 1


Historic Grizzly Habitat
Potential in British Columbia
1999
Ecosection
Grizzly Bear
Population Units
Very High
High
Medium
Low
Very Low
Nil
Never Occupied
BRITISH
COLUMBIA

Grizzly bears were an important part of the culture of the over 70,000 native inhabitants of British Columbia prior to European contact. Many hunted them, used their claws and skins in ceremony and wove the grizzly bear into their dances, myths and legends (Shepard and Sanders 1985). Many BC aboriginal people shared the myth of the Bear Mother (Barbeau 1946). The Kaska from the area around Dease River in north central British Columbia also "believed that fire was first the possession of a bear who could obtain sparks from a firestone" (Shepard and Sanders 1985). There is no doubt that the First Nations of British Columbia killed grizzly bears. We can only speculate about how many and how often, but we believe the kill was very low. Information about their respectful rituals and customs about hunting and addressing the slain bears is found throughout the ethnographies (e.g. Hallowell 1926). The Kutenai (East Kootenays) used dogs for hunting bears. In his description of the Thompson Indians, Teit (1900) identified use of bows and arrows, dogs and dead fall (log) traps. Teit's book is one of the few descriptions of aboriginal grizzly bear hunting in British Columbia:

> "To kill black bear or cougar was considered no great feat; but the hunter who had killed, single-handed, grisly [sic] and especially silver-tip bear, was highly respected for his courage; and for this reason many young men hunted the grisly. Many stories are related of desperate encounters with this animal. The introduction of the repeating-rifle has minimized to a great extent the dangers of such encounters. The Indians claim that the grislies were much less fierce in some parts of the country than in others."

British Columbia's aboriginal people also killed bears in defence of life or food. Salmon drying racks and oolichan (*Thaleichthys pacificus*) processing sites were likely powerful attractants. Packing rendered oolichan fat (a major trade good) into the interior of the province along the "grease" trails likely resulted in conflicts with both black and grizzly bears. Aboriginal people also enhanced grizzly bear habitat when they deliberately burned forested areas to improve berry productivity (Turner 1999). Given the relatively small number of First Nations people in British Columbia prior to European contact – many of them concentrated in areas outside the range of grizzly bears such as the Queen Charlotte Islands and Vancouver Island (Duff 1964) - we suggest that there was little direct population impact on the species.

The Spanish explorers described grizzlies as early as 1602 in Monterey, California (Storer and Tevis 1955) and documented grizzlies there again in 1769. It is possible that grizzly hides were among the fur trade items during the early marine trading period in British Columbia prior to 1790 but we can find no record of it. It is also possible that the independent expeditions by Cayetano Valdes (along with Dionisio Galiano) and George Vancouver in 1792 learned of grizzly bears when they entered Burrard Inlet, the current site of the city of Vancouver. The surrounding area, including the Fraser Valley estuary, was among the most productive grizzly bear habitats in the province. Not only would local grizzly bears have access to the estuary, berry feeding sites and numerous salmon spawning areas, the lower Fraser River drainage also supported a large herd of Roosevelt elk (Spalding 1992). Vancouver's party may have also encountered grizzly bears at the mouth of the Kiltuish River on June 25th, 1793. Botanist Menzies records that "we saw two very large Bears but they made off on seeing us into the woods before we could have a shot at them" (Lamb 1984).

Alexander Mackenzie appears to have encountered grizzly bears at least twice during his trip across the province in 1793. On May 16th Mackenzie observed two grizzly bears on the Peace River east of Hudson's Hope ("two grisly and hideous bears"), having seen tracks and a den 3 days before. Mackenzie recorded that "the Indians entertain great apprehension of this kind of bear, which is called the grisly bear, and they never venture to attack it but in a party of at least

three or four" (Lamb 1970). On July 24th one of Mackenzie's party was threatened by a female bear with cubs on the Bella Coola River. They killed the adult female but left the cubs alive (Lamb 1970). We are not certain if this was a grizzly or black bear family group, but Mackenzie does record that the meat "was very indifferent." Defensive attacks by adult female black bears in BC are extremely rare; the behaviour described in Mackenzie's journal is more typical of a female grizzly protecting her cubs. Simon Fraser's party also saw grizzly bears, and one of them was mauled by an adult female protecting her cubs. This somewhat confusing incident occurred on July 13th, 1806, near the mouth of the Nechako River at present day location of the city of Prince George. Fraser's journal entry for the day suggests "had not the dogs passed there at that critical moment, he [La Garde] would have been torn to pieces". There were two aggressive bears involved (Lamb 1960) and La Garde escaped with "nine or ten bad wounds". The party had come ashore to shoot two cubs out of a tree and it is appears that they encountered the defensive adult female. Apparently, they "fired upon her to no effect". In the twelve years David Thompson travelled British Columbia he does not note seeing or killing a grizzly bear, despite knowing of them. Local First Nations did give him some grizzly bear meat (Belyea 1994). On January 7th, 1811 Thompson and his men came across a huge track that he thought may have been made by a "large old grizzled bear" (Hopwood 1971).

The end of the maritime fur trade roughly coincided with the War of 1812. Sea otter and fur seal pelts had become rare. However, the land-based fur trade for beaver, river otter, foxes, elk, and both black and grizzly bears began in earnest and a series of Forts and trade routes were established by the Northwest and Hudson's Bay companies. In the few records we have examined, it is difficult to get an estimate of the number of grizzly bear pelts traded. Black and grizzly bear hides were often treated as equivalent (brown bears are sometimes listed, but not distinguished by species). Regardless, grizzly bear hides were definitely a commodity (Meilleur 1980), placing some pressure on populations on the coast and in the Central and Southern half of the province until about the late 1840's.

A more concentrated grizzly population impact occurred because of BC's various gold rushes. First Nation's people from Haida Gwaii and the lower Fraser River brought gold to Fort Victoria in the early 1850's. At that time, there were about 600 non-native people in the area that would eventually become British Columbia. By the summer of 1858 over 30,000 more people required food, transportation, and land and timber for settlement and housing. Placer mining for gold was particularly disruptive in the rich riparian habitats in the placer areas of the Central Interior. Grizzly human conflicts were likely common (e.g. competition over carcasses as miners attempted to feed themselves with local game). The Cariboo gold rush began in 1860 and peaked in 1863. During that time, the community of Barkerville had 10-12,000 people in an area still known for its grizzly bear habitat suitability.

A "hard rock" mining boom in the Kootenays began in the 1880's and culminated in the find of the huge Sullivan mine at Kimberly in 1892. Prospectors burned extensive areas of forest to expose outcrops, creating some areas of enhanced feeding habitat for grizzly bears. Settlements that sprang up as a result of the mines and their associated transportation networks (e.g. Princeton, Sandon, New Denver, Nelson, Rossland, Trail), resulted in the displacement and direct killing of grizzly bears. More recently, open pit coal mining in both the Southern and Northern Rockies has resulted in direct loss of grizzly bear habitat, although there has been some success in mine rehabilitation to grizzly bear forage species. The oil and gas boom in the northeast of the Province has created thousand's of kilometers of open road and ATV trails, significantly increasing grizzly bear mortality risk.

The current un-occupied area showing where resident grizzly bears no longer exist roughly corresponds to the distribution of cattle ranches and Crown livestock ranges in the province. It is likely that conflicts between grizzly bears and cattle date back to the earliest ranches established south and west of Kamloops in the early 1860's. Cattle from these ranches were driven north to Barkerville to help feed the miners. Ranching gradually expanded in the 1870's and the liberal land policies led to the establishment of some of the biggest ranches in Canada. For example, up until "the late1880's, land could be pre-empted in the interior of the province at $1 an acre and grazing land could be leased at an annual rent of six cents an acre" (Woodcock 1990). Large ranches were established in the Peace, Cariboo, Chilcotin and Nicola regions. The Douglas Lake ranch in the Nicola valley ran 10-12,000 head of cattle on five hundred thousand acres in the 1950's and 1970's (Wolliams 1979). There are hearsay accounts that the ranch hands and cowboys of such operations were paid a premium for killing grizzly bears, but we can find no verification. Regardless, the intolerance of cattle-killing grizzly bears is well established and continues to today.

Aside from the obvious impacts created by the construction of logging roads and railroads into former wilderness areas, forest development has had another major impact on grizzly bears in British Columbia through the creation of extensive areas of even-aged, 40-120 year old forests with little or no forage in their understories. Two practices exacerbated the creation of these extensive low value habitats: the onset of planting replacement conifer seedlings after clearcutting (1930's) and organized, effective fire suppression (1940's). While it may be argued that clearcutting has somewhat replaced the early seral habitats used by grizzly bears following wildfire, high rates of cut subsequent to advances in yarding methods and rigorous reforestation requirements have mitigated that substitution. Boom and bust forage cycles have, in many coastal and wetbelt interior landscapes, influenced the ability of the land to support grizzly bears. Although grizzly bears feed extensively in recently harvested areas, they are subject to increased mortality risk while doing so (especially near road networks connected to communities). Critical habitat impacts (e.g. logging or logging infrastructure adjacent to spawning channels, avalanche tracts or coastal estuaries) were historically an issue, but are less so today. Similarly, conflicts between grizzly bears and logging crews were historically common but are rare today. Bears were often shot after being attracted to improperly stored food or to garbage at remote camps.

The impact on British Columbia's grizzly bears created dams and reservoirs built to provide community water or hydro-electric power generation should not be underestimated. There are currently at least 65 dams whose reservoirs cover over thousands of square kilometers. The valley bottom, lower slope and riparian habitats that were flooded were among the most productive ecosystems for grizzly bears in the province. The additional loss of spawning salmon – notably in the Columbia River and Bridge River systems – had a population-level impact on grizzly bears that formerly migrated to take advantage of that excellent seasonal food source.

A slower, but even more likely influence on BC's historic grizzly population is associated with the creation of various trails, roads, railroads, interior sternwheeler and coastal steamer routes. The eight major passes into the province and 5 major river systems determined the interior routes. At one time there were over 300 active sternwheelers hauling freight and passengers into grizzly country. The Cariboo Wagon Road connected Yale and the Cariboo gold fields with a side route to Kamloops (1860-1866) and the Dewdney Trail (1858) created a major east-west route from the lower Fraser through Allison Pass to the Similkameen and eventually to Cranbrook. The Canadian Pacific Railway, completed in 1885, provided unparalleled luxury and

convenient travel across the country, as did the Grand Trunk railway connecting Edmonton and Prince Rupert (1915). However, it was with the arrival of the automobile that access really left its mark on the province: between 1902 and 1910 road mileage went up from 6,345 to 14, 633 miles (10,209 to 23,545 km) (Harvey 1998). By 1925 all of the major southern valleys were either roaded or serviced by branch rail lines. The Union Steamship company was then in its period of greatest expansion, servicing dozens of coastal communities, logging camps and First Nation settlements (Rushton 1978). There are currently over 507,576 km of open roads in British Columbia (Ferguson et al. 2002), and while most of the coastal steamers are gone, the BC Ferries system and a variety of coastal airlines maintain human access to even the remotest areas of the coast. The impacts of open roads on grizzly bears are well documented (e.g. Mace 1999).

Of all the historic factors influencing British Columbia's grizzly bear population, none is perhaps more indicative than the simple arithmetic of human population growth. This "human footprint" manifested by the settlements, transportation and utility corridors, agricultural areas, logging, mining, and hydroelectric development has undoubtedly been the biggest impact on British Columbia's grizzly bear population (see McLellan 1998). The expanding non-Native population over the last 200 years killed grizzly bears as competitors for space, for food, and for livestock and brought with them an interest in grizzlies as a trophy species. As important as these direct mortality influences have been locally and historically, it is primarily the loss, alteration and alienation of habitat and ongoing population level fragmentation that gives us the pattern of grizzly bear density we observe in BC today.

Grizzly Bear Population Estimation in British Columbia

Comments regarding grizzly bear abundance in British Columbia are common in the reports of the Province's Game Commission (1911 to 1956, see Lloyd 1975). Descriptions of relative abundance in localized areas of the province are given along with indications of fluctuating natural food supplies that resulted in varying levels of livestock depredation and other agricultural conflict. In the 1950s and 1960s game managers were reluctant to even hazard a guess about the number of bears in the province. For example, Jim Hatter, former Fish and Wildlife Branch Director, stated that "for grizzly bear, black bear, wolf and cougar there is no estimation, furthermore, because of the extremely low degree of use, insufficient information is available to even make educated guesses" (Hatter 1963). Managers of the day believed the grizzly bear population of the province "is larger than any other in North America" (Bandy 1964) and that populations were "at capacity in most of the area it inhabits" (Hatter et al. 1956).

Our agency's first provincial grizzly bear population estimate is in the May 1972 Management Plan for British Columbia's Grizzly Bears (Spalding et al. 1972). Their estimate of 5-8,000 bears was qualified by the authors, "No biologist is happy about the accuracy of these estimates and by common consent a comprehensive province-wide inventory is the first program to innovate." Some attempt at density extrapolation had already been made. Fred Harper, former Regional Wildlife Biologist in Fort St. John, submitted a report to headquarters in January 1971. Harper's report contained a map and associated tables of population estimates for individual Northern Management Areas and he identified a suspected hunter overharvest based on those estimates (Harper 1971). Harper used densities of 2 to 5 bears/1000 km^2 in four different physiographic/geographic areas. These expected densities, while low by today's standards, were based on the scientific literature of the day, and the biologist's "guesstimates" from that information.

The Information Section of the Fish and Wildlife Branch promoted an estimate of "6,500 - stable or decreasing" in the mid 1970s based on the Spalding et al. (1972) management plan. Two coastal Fish and Wildlife Branch regions conducted annual track counts along spawning channels in several coastal rivers in the 1970s based on the methods described by Klein (1959). Weather and access problems restricted reliability (Forbes 1979) but repeated annual surveys did provide a comparative basis for regional harvest management.

In 1977, Dan Blower, Inventory Biologist for the Fish and Wildlife Branch, released his grizzly bear distribution and relative abundance map and updated the grizzly bear population estimate for the province (Blower 1977, Table 2). The more detailed summary of Blower's work in Tompa (1977) again shows use of density estimates for ecological and geographic areas that are low by today's standards (Table 4) with averages ranging from 2 bears/1000 km^2 to 19 bears/1000 km^2. Blower used broad topography and climate information (1:2,000,000 scale) and recognized a significant area of the province had been extirpated by the mid 1970s. The "Not Present" category on his map approximates the current, more detailed occupied line (Figure 2). One group of bears shown on Blower's map (Pennask Lake, east of Kelowna) now appears to be largely extirpated, as there have been only a few recent sightings in the vicinity.

Blower's estimate of 6,600 (6-7,000) was used in the Preliminary Grizzly Bear Management Plan for British Columbia (Petticrew and Munro 1979). Their density categories (few, moderate, plentiful) were based on "habitat distributions, subjective regional knowledge and preliminary research findings" (Petticrew and Munro 1979). It is interesting to note that Blower's original range (5-11,000) was changed in this more recent summary but the reasons were not given. The only reported grizzly/brown bear population densities we can find reported for study areas within British Columbia by 1979 were the 36-55 bears/1,000km^2 of Mundy and Flook (1973) and the 31-34 bears/1000 km2 noted by Hamer (1974). Both were considerably higher than Blower's "plentiful" category of 19 bears/1,000km2. Pearson (1975) had also published a population density for Kluane Park in the southwest Yukon (37-44 bears/1,000 km^2), arguably representative of the extreme northwest of British Columbia. Blower too lacked confidence in his estimates: "Figures in this table show an approximate density distribution of grizzly bears throughout the Province, based on habitat distributions. Hunting regulations require more precise knowledge of populations within Management Units" (Blower 1977, underlining by the author).

The estimate of 6,600 grizzly bears was used through the early 1980s. Frank Tompa, Carnivore Specialist, reported the estimate and hypothesized an overharvest of grizzly bears based on a detailed examination of kill data from Compulsory Inspection records (Tompa 1984a,b). Later in 1984, in correspondence with Richard Harris, then at the University of Montana, Tompa uses higher densities for the first time: (33-67 bears/1,000 km^2 for Coastal and Southern Rocky Management Units, 12 bears/1,000km^2 for the Northern Rockies) (Tompa 1984c). However, Tompa did not translate these densities into a provincial estimate and appeared to be opposed to density extrapolation based on habitat. "Regional and provincial population estimates, largely based on sight records, anecdotal information, few local surveys, and extrapolations on the basis of habitat availability, with reference to assumed habitat specific densities, can be grossly misleading. Their usefulness is limited to determine, in broad terms, the grizzly bear distribution in the province, describe habitat occupancy and, locally, to estimate coarse relative densities" (Tompa 1984b).

Ben van Drimmelen, Regional Wildlife Biologist for the Skeena Region, was the first biologist in the province to examine the utility of the using British Columbia's ecological land

classification system for grizzly bear population estimation (van Drimmelen 1985). Van Drimmelen used the well-established Biogeoclimatic Ecosystem Classification (BEC) (Krajina 1965) and attempted to apply the new Biotic Region Classification developed by Dennis Demarchi (this system eventually became the Ecoregion Classification for the province). Van Drimmelen used 50 bears/1,000 km^2 for the Coastal Western Hemlock zone based on fieldwork in the Kimsquit on the central coast River (Hamilton, unpublished data). Similarly, van Drimmelen used 29 bears/1,000 km^2 for the Interior Cedar Hemlock zone based on work underway near Revelstoke (Simpson 1985). Density estimates from other studies in Alaska and Alberta were applied to other BEC zones based on van Drimmelen's assessment of their ecological similarity. van Drimmelen estimated 3,780 grizzly bears for the Skeena Region with this density extrapolation method. The current minimum estimate for the same area is 4,282 bears.

Table 2.: Statistics from April 1977 Grizzly Bear Distribution and Relative Abundance Map* (compiled by Dan Blower)

Resource Management Regions	RELATIVE ABUNDANCE CATEGORIES						Population projections based on abundance categories	
	FEW		MODERATE		PLENTIFUL			
	Area in Mi^2	Area in Km^2	Area in Mi^2	Area in Km^2	Area in Mi^2	Area in Km^2	Estimated No. of animals	% of Total Estimates
1. Vancouver Island	516	1,336	469	1,215	2,750	7,122	150	2%
2. Lower Mainland	5,875	15,216	1,734	4,491	1,109	2,872	120	2%
3. Thompson/Okanagan	8,375	21,690	6,641	17,200	156	404	180	3%
4. Kootenay	11,063	28,653	11,250	29,137	7,395	19,153	650	10%
5. Cariboo	9,984	25,858	12,250	31,727	6,969	18,050	640	10%
6. Skeena	11,922	30,878	36,016	93,281	45,828	118,694	3,070	46%
7. Omineca-Peace	50,422	130,592	66,125	171,263	5,422	14,043	1,850	28%
Total in each category	98,157	254,223	134,485	348,314	69,629	180,338	6,660	100%

Categories:

Few
- 1 bear per 75-500 sq. miles (Est. Average = 1 grizzly bear / 200 sq. mi.)
- 1 bear per 194 – 1,295km^2 (Est. Average = 1 grizzly bear / 518km^2.)

Moderate
- 1 bear per 25-75 sq. miles (Est. Average = 1 grizzly bear / 50 sq. mi.)
- 1 bear per 65 – 194km^2 (Est. Average = 1 grizzly bear / 129km^2.)

Plentiful
- over 1 bear per 25 sq. miles (Est. Average = 1 grizzly bear / 20 sq. mi.)
- 1 bear per 65km^2 (Est. Average = 1 grizzly bear / 52km^2.)

*Figures in this table show an approximate density distribution of grizzly bears throughout the province, based on habitat distributions. Hunting regulations require more precise knowledge of populations within Management Units.

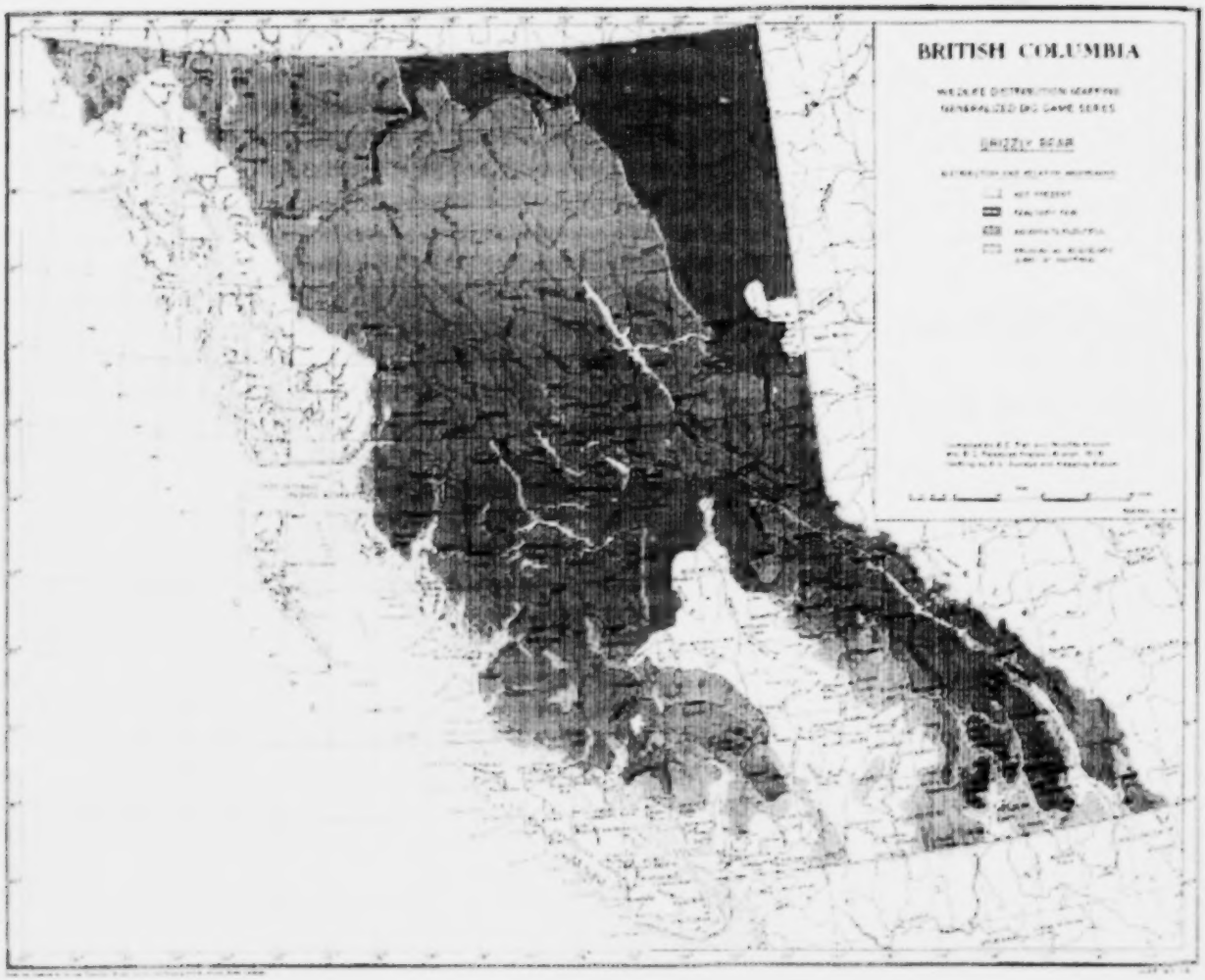


Figure 2: Estimated Grizzly Bear Distribution and Abundance in British Columbia circa 1978

Table 3: Current Population Estimates and Densities for Grizzly Bears by Management Unit Compared to 1990

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Density
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000km^2
1	14	178	139	4,273	42	32	120	21
1	15	147	117	3,598	41	33	127	23
2	1	29	0	721	40	0	0	
2	2	30	2	975	31	2	0	
2	3	35	0	977	36	0	0	
2	5	47	12	1,782	26	7	0	
2	6	62	11	2,321	27	5	0	
2	7	24	1	917	26	1	0	
2	8	76	4	2,777	27	1	0	
2	9	43	10	1,611	27	6	0	
2	10	30	5	1,084	28	5	0	
2	11	72	18	2,892	25	6	0	
2	12	50	6	1,776	28	3	2	1
2	13	59	22	2,209	27	10	23	8
2	14	53	20	2,170	24	9	9	4
2	15	73	23	2,470	30	9	13	4
2	17	36	5	992	36	5	0	
2	18	48	7	1,420	34	5	0	
2	19	24	4	711	33	5	0	
3	13	37	3	1,267	29	2	0	
3	14	36	1	1,081	33	1	0	
3	15	52	20	1,988	26	10	0	
3	16	53	28	2,735	19	10	35	11
3	32	72	36	4,546	16	8	15	4
3	33	31	15	1,441	21	11	20	9
3	34	13	5	465	28	10	0	
3	35	34	20	808	42	25	15	18

Table 3 (cont.)

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Density
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000km^2
3	36	79	40	2,568	31	16	30	11
3	37	33	19	1,421	23	13	0	
3	38	31	17	1,650	19	10	0	
3	39	34	14	1,509	23	9	0	
3	40	38	23	1,643	23	14	0	
3	41	23	12	947	24	13	6	6
3	42	43	30	1,483	29	21	0	
3	43	31	22	1,058	29	21	30	26
3	44	51	37	1,613	31	23	30	17
3	45	55	55	2,059	27	27	0	
3	46	87	86	2,832	31	31	0	
4	1	108	108	1,554	70	70	100	68
4	2	70	65	1,225	57	53	50	42
4	3	53	24	1,602	33	15	0	
4	4	48	20	1,098	44	18	10	10
4	5	33	21	837	40	25	40	49
4	6	75	52	2,226	34	23	60	27
4	7	66	33	1,884	35	18	40	23
4	8	65	25	2,151	30	12	10	4
4	9	36	12	1,199	30	10	0	
4	14	29	10	884	33	11	15	18
4	15	70	24	1,698	41	14	50	29
4	16	69	24	1,749	40	13	40	24
4	17	79	47	1,657	48	28	40	25
4	18	56	35	1,369	41	26	30	22
4	19	45	39	1,391	32	28	40	26

Table 3 (cont.)

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Density
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000km^2
4	20	129	80	3,798	34	21	90	24
4	21	52	40	1,314	40	30	25	18
4	22	107	82	2,365	45	35	85	36
4	23	195	145	3,297	59	44	110	35
4	24	92	70	1,835	50	38	60	33
4	25	147	116	3,104	47	37	80	27
4	26	119	90	3,074	39	29	75	21
4	27	44	36	1,438	30	25	40	24
4	28	25	21	745	33	28	25	29
4	29	31	29	797	40	36	25	30
4	30	58	54	1,270	45	43	45	35
4	31	69	28	1,249	55	23	50	39
4	32	127	51	2,448	52	21	50	20
4	33	85	72	2,141	40	33	70	30
4	34	129	92	3,851	34	24	110	28
4	35	121	88	2,605	46	34	65	25
4	36	144	110	3,887	37	28	130	33
4	37	57	45	1,942	29	23	50	23
4	38	179	140	3,650	49	38	85	28
4	39	127	106	2,392	53	44	90	35
4	40	60	48	2,197	27	22	75	29
5	1	5	2	238	21	8	0	
5	2	67	35	2,266	29	15	20	1
5	3	15	9	1,264	12	7	30	8
5	4	67	32	6,126	11	5	55	6
5	5	60	33	4,824	12	7	37	9

Table 3 (cont.)

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Density
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000km^2
5	6	83	72	5,111	16	14	50	10
5	7	207	113	6,122	34	18	285	43
5	8	225	144	6,916	32	21	250	36
5	9	226	160	6,553	34	24	250	39
5	10	83	83	3,322	25	25	0	
5	11	36	36	1,893	19	19	32	16
5	12	55	39	8,136	7	5	62	6
5	13	45	27	8,133	6	3	35	2
5	15	353	184	9,018	39	20	125	13
5	16	39	39	1,049	37	37	0	
6	1	105	71	5,284	20	13	56	10
6	2	123	105	4,236	29	25	64	14
6	3	352	171	11,089	32	15	328	29
6	4	109	54	8,038	14	7	71	8
6		18	12	1,014	17	12	6	6
6	6	74	39	2,478	30	16	33	13
6	7	170	138	4,354	39	32	111	35
6	8	301	168	9,365	32	18	136	14
6	9	411	243	13,475	31	18	356	24
6	10	48	38	1,308	37	29	60	34
6	11	189	120	6,032	31	20	120	26
6	14	300	224	7,687	39	29	242	26
6	15	298	222	8,397	36	26	273	31
6	16	199	144	5,133	39	28	166	26
6	17	313	226	9,910	32	23	339	34
6	18	189	151	6,539	29	23	139	22

Table 3 (cont.)

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Dens[illegible]y
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000 km^2
6	19	122	88	7,499	16	12	68	9
6	20	253	233	13,761	18	17	216	15
6	21	411	319	13,389	31	24	337	20
6	22	269	215	11,013	24	20	296	23
6	23	216	122	10,807	20	11	96	9
6	24	165	105	9,240	18	11	67	8
6	25	299	221	15,536	19	14	112	8
6	26	435	355	16,580	26	21	189	10
6	27	96	67	4,971	19	13	43	7
6	28	38	32	3,047	12	10	34	10
6	29	178	172	5,877	30	29	98	10
6	30	301	226	6,680	45	34	249	35
7	1	40	39	2,134	19	18	71	32
7	2	77	76	3,085	25	45	97	30
7	3	104	100	3,757	28	45	120	32
7	4	54	54	2,382	23	26	62	22
7	5	120	109	2,955	41	37	90	31
7	6	74	64	1,989	37	32	43	21
7	7	85	82	2,940	29	28	29	10
7	8	28	12	1,309	21	9	12	8
7	9	25	16	1,731	14	9	12	7
7	10	7	7	1,428	5	9	0	
7	11	14	14	1,843	8	9	13	7
7	12	39	39	5,087	8	9	38	7
7	13	23	23	2,662	9	9	20	8
7	14	8	8	1,611	5	9	11	6

Table 3 (cont.)

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Density
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000km2
7	15	11	11	2,220	5	9	15	7
7	16	97	34	3,715	26	9	94	25
7	17	103	121	2,703	38	45	108	39
7	18	114	167	3,744	30	45	157	40
7	19	122	113	4,325	28	26	149	35
7	20	55	46	3,248	17	14	30	7
7	21	179	139	6,093	29	23	256	38
7	22	157	131	4,119	38	32	199	48
7	23	169	193	4,323	39	45	230	52
7	24	37	44	4,836	8	9	36	7
7	25	47	37	4,051	12	9	40	10
7	26	58	29	3,200	18	9	50	15
7	27	171	171	5,312	32	34	180	32
7	28	214	214	7,470	29	34	210	28
7	29	70	70	3,241	21	24	60	17
7	30	71	71	2,166	33	45	80	35
7	31	183	157	5,276	35	30	247	47
7	35	33	2	1,517	22	2	24	12
7	36	96	85	3,095	31	27	127	46
7	37	155	155	6,041	26	28	175	28
7	38	362	356	12,674	29	28	350	28
7	39	132	132	8,646	15	18	80	9
7	40	148	148	7,376	20	21	60	9
7	41	202	207	7,756	26	27	300	38
7	42	172	124	5,975	29	21	64	11
7	43	99	64	3,031	33	21	112	21

Table 3 (cont.)

Region	Management Unit	Estimated Current Minimum Number of Bears		Useable Land Area km^2	Estimated Current Minimum Bears per 1,000km^2		1990 Estimate	1990 Density
		Current Capability	Post Stepdown		Current Capability	Post Stepdown	Bears	Bears Per 1,000km^2
7	44	46	39	2,361	19	16	0	
7	45	84	65	5,266	16	12	44	7
7	46	36	29	5,694	6	5	44	7
7	47	103	95	9,821	10	10	73	7
7	48	145	132	6,983	21	19	53	7
7	49	174	155	10,934	16	14	73	1
7	50	225	210	6,704	34	31	64	9
7	51	347	320	18,155	19	18	292	16
7	52	315	288	17,303	18	17	129	9
7	53	240	223	9,809	25	23	85	9
7	54	190	170	7,400	26	23	48	8
7	55	23	21	17,729	1	1	0	
7	56	19	18	15,703	1	1	0	
7	57	73	58	2,515	29	23	0	
7	58	30	15	785	39	19	0	
8	3	21	0	1,196	18	0	0	
8	4	19	1	900	21	1	0	
8	5	51	8	1,530	33	5	0	
8	10	1	0	71	21	4	0	
8	13	19	5	565	34	9	11	18
8	14	38	9	1,136	34	8	14	6
8	15	79	21	2,313	34	9	55	19
8	23	59	26	1,981	30	13	50	19
8	24	30	9	1,208	25	7	12	9
8	25	4	1	175	22	3	0	
8	26	3	1	149	20	5	0	
Total		**18,828**	**13,834**	**743,871**			**13,069**	

Table 4: British Columbia Grizzly Bear Population Densities from Research and Inventory Projects

Study Area	Project Type	Population Estimate	Confidence Interval		Density Estimate (Bears /1,000km^2)	Confidence Interval (Bears /1,000km^2)		Reference
Glacier National Park	Mark-Resight	45			36	36	55	Mundy and Flook 1973
Mountain Creek Glacier National Park	Research				34	31	34	Hamer 1974
Flathead	Research				80			McLellan 1989
Columbia Mountains	Research		12		31			Simpson 1985
Khutzeymateen Park	Research	55				68	90	MacHutchon et al. 1993
South Selkirks	Research		16	21	23	20	27	Weilgus et al. 1994
Kootenay & Yoho Parks	Research					6	11	Raine and Riddell 1991
Nass Wildlife Area	Aerial Survey	57			21	21		Demarchi et al. 2000
Central Selkirks	DNA Mark-Recapture	262	224	313	26	23	32	Mowat and Strobeck 2000
Jumbo	DNA Mark-Recapture	39	34	62	25	22	40	Strom et al. 1999
Flathead	DNA Mark-Recapture	156	97	296	48	30	92	Boulanger 2001a
West Slopes 96	DNA Mark-Recapture	77	51	155	19	13	39	Boulanger 2001b
West Slopes 97	DNA Mark-Recapture	47	37	79	26	21	44	Boulanger 2001b
West Slopes 98	DNA Mark-Recapture	59	37	125	27	17	56	Boulanger 2001b
Prophet River	DNA Mark-Recapture	131	112	178	16	13	21	Poole et al. 2001
Granby Kettle	DNA Mark-Recapture	38	26	84	9	6	19	Boulanger 2000
Kingcome	DNA Mark-Recapture	102	77	163	41	32	62	Boulanger and Himmer 2001
Parsnip River Mountains	DNA Mark-Recapture	326	276	409	51	44	65	Mowat et al. 2002
Parsnip River - Plateau	DNA Mark-Recapture	34			12			Mowat et al. 2002

In the summer of 1987, Wildlife Habitat Ecologist Brian Fuhr and Hamilton conducted field reconnaisance sampling in the Omineca Subregion near Prince George (Fuhr 1987). The area was flown in both fixed and rotary-wing aircraft and included landing for plot work and transects to characterize forage availability and look for permanent bear signs (mark trees, trails, beds). Fuhr later used 1:500,000 regional wildlife habitat maps (with their BEC and biophysical habitat stratification) to apply four density categories based on relative productivity (e.g. the extent of productive avalanche chutes) and the degree of human influence: High: 67 bears/1,000 km^2, Moderate: 22 bears/1,000 km^2, and Low: 7 bears/1,000 km^2.

In the fall of 1987, Provincial Carnivore Specialist Ralph Archibald initiated a project to re-map grizzly bear distribution at 1:600,000 scale and to record relative population densities using the following assigned density classes: High: >15 bears/1,000km^2, Medium: 5-15 bears/1,000 km^2, and Low: 2-5 bears/1,000 km^2 . A class for "occasional" was added for densities <2 bears/1,000 km^2. The area by density class within 153 occupied Management Units (MUs) was estimated using a manual electronic planimeter.

In 1989, a Grizzly Bear Harvest Review Committee was struck by the Wildlife Branch. The work of this committee culminated in several key recommendations regarding harvest management. The committee also assisted with a revision of the provincial grizzly population estimate to 13,190 bears (Table 3) (see also Fuhr and Demarchi 1990). By 1990, several British Columbia research projects provided density estimates (Table 4) (Mundy and Flook 1973, Hamer 1974, Simpson 1985, McLellan 1989, Raine and Riddell 1991). The Harvest Review Committee and Fuhr and Demarchi (1990) took advantage of that work in their density ratings of habitats across the province.

This approach of assigning grizzly bear densities to habitats was formalized as Fuhr and Demarchi (1990) and has been referred to since as the "Fuhr-Demarchi" method. Although van Drimmelen had used the provincial ecological classifications to spatially apply bear densities three years before, Fuhr (1987) "stepped down" their density assignments based on an examination of access, logging, settlement, agriculture and hunter harvest history and also integrated information from biophysical, BEC and Ecoregional mapping. Bear densities used by Fuhr and Demarchi (1990) were based on a table by McLellan (1989) that showed the highest densities found in North America. They compared these high densities with those for other ecosystems and assigned classes to Biogeoclimatic zonal units stratified by Ecosection. Class 1 habitats were assigned the highest known density (actually a range represented by 76-100% of the highest), class 2 was 51-75% of the highest, class 3 was 26-50%, class 4 was 6-25%, class 5 was 1-5% and class 6 was nil. This work set the precedent for our current system, ultimately becoming the Resource Inventory Committee Standard (RIC 1999);

Vivian Banci, Provincial Carnivore Specialist, expanded the work of the Harvest Review Committee and Fuhr and Demarchi in her examination of the status of grizzly bears in Canada (Banci 1991). Banci proposed 12 grizzly bear zones for the country and carefully evaluated current threats, status and trend within each of these zones. British Columbia's estimated 13,000 grizzly bears accounted for 52% of the Canadian total estimate of 25,320 animals. Throughout the 1990s, the official provincial grizzly bear estimate was given as 10-13,000 bears. The 13,000 figure is based on Fuhr and Demarchi (1990) and the Harvest Review Committee, but we are uncertain about the origin of the 10,000 bear minimum estimate. We suggest that it was used on a non-scientific basis to reflect the assumed lack of precision in the population estimate.

The early 1990s also marked the beginning of the use of Geographic Information Systems (GIS) to assist in the process of developing grizzly bear population estimates. GIS was first used in 1991 on a test basis for the Skeena Region. Regional maps of Management Units, Guide Outfitter Territories, BEC zones and Ecosections were digitized and intersected. Three density categories were used: High: 67 bears/1,000km^2, High to Medium and Medium: 22 bears/1,000 km^2, Medium to Low and Low: 7 bears/1,000 km^2. This project marked the first formal application of the Fuhr-Demarchi (1990) system: unique combinations of Ecosections and BEC zones, subzones, variants were rated separately. The resulting estimate for the region was 4,611 grizzly bears (Hamilton 1991), considerably higher than the 3,780 bears estimated by van Drimmelin (1984). Again, the current minimum estimate for the Skeena Region is 4,282 animals.

In 1993, Hamilton coordinated a provincial GIS-based re-mapping of grizzly bear densities based on a revised provincial BEC map and Ecosection boundaries. Hamilton noted in his memo to regional staff about this project that the stepdown process "was largely subjective and not necessarily comparable among regions" and was in need of standardization.

The subsequent distribution, to regional offices, of spreadsheets of the pre-stepdown, current habitat potential ratings and estimated bear densities by MU, Guide Outfitter Area, Ecosection and BEC zone, subzone, variant and phase marked the first of several iterations in the 1990s. During each release, Dennis Demarchi (Provincial Habitat Correlator) and Hamilton would review the latest densities from research and inventory projects and would adjust current potential ratings of each unique combination of Ecosection and BEC unit accordingly. We also received comments from regional staff regarding these ratings, and altered our ratings table to reflect their input and to ensure correlation across like units.

Current Population Estimation Methodology

The base classifications and maps for our habitat-based density estimation system are the evolving Ministry of Forests Biogeoclimatic Ecosystem Classification (BEC) products (Pojar et al. 1987) and our Ministry's Ecoregional classification and maps (Demarchi et al. 1990). Both inventories are under continuous evolution to larger map scales, increased correlation among units and are subject to periodic revisions of map boundaries.

We use a 6 class system to rate each unique combination of Ecosection and BEC unit (to the phase level in the hierarchy) according to the principles in Fuhr and Demarchi (1990). The benchmark habitat potential density is 100 bears/1,000 km^2 for a class 1 unit. All other classes are scaled against that density by percentage range (Table 5). For calculation of total allowable human mortality we use the estimates derived from the minimum range. For example, a class 1 minimum density is 75% of 100 bears/1,000 km^2 or 75 bears/1,000 km^2. We typically report population estimates as these minimums (after stepdown).

Table 5: Current Habitat Potential and Densities for Grizzly Bears

Current Habitat Potential Class	Class Name	Percentage Minimum	Percentage Maximum	Minimum Bears/1,000km^2	Maximum Bears/1,000km^2
1	Very High	75%	100%	75	100
2	High	50%	75%	50	75
3	Medium	25%	50%	25	50
4	Low	5%	25%	5	25
5	Very Low	0	5%	1	5
6	Nil	0	0	0	1

For scaling units, we closely examined two intensively researched study areas: the Flathead River drainage in the southeastern interior British Columbia (McLellan 1989, 1994) and the Khutzeymateen River drainage on the northwest coast (MacHutchon et al.1993). Both study areas were assumed to be operating near carrying capacity and documented densities of over 80 bears/1,000km^2 (Flathead) and 68-90 bears/1,000km^2 (Khutzeymateen). Dennis Demarchi and Hamilton used their knowledge of grizzly bears and the various Ecosection/BEC units to rate the habitat capability of unique combinations of Ecosection and BEC units relative to these two benchmark areas.

Several productivity filters were applied to the comparative ratings. In general, wetter units are ranked higher than drier (except the extreme "hypermaritime" outer coast), lower elevation units are ranked higher than upper elevations, mountainous units are ranked higher than rolling or flatter units, and more diverse units were ranked higher than uniform ones. BEC subzones in the interior also have a relative temperature assignment. For example, an "mw" subzone is "moist warm" (Meidinger and Pojar 1991). Generally warmer units were ranked higher than cool or cold units, however, this was relative to a given zone only. If the zone was a drier/warmer zone to begin with, the warmer or hotter unit(s) were ranked lower.

Generally, the same BEC unit across Ecosections were givens the same rating, however, there were some exceptions. The higher the diversity of zones, subzones, variants and phases within an Ecosection, the higher the individual BEC ratings within it. For example, the Montane Spruce Dry Cool (MSdk) subzone in the Flathead River drainage is found below an extremely productive Engleman Spruce Subalpine Fir warm moist subzone (ESSFwm) and is ranked as class 1. The same MSdk BEC unit in the rolling McGillvary Ranges to the west of the Rocky Mountain Trench is only class 2 because grizzly bears in the McGillvary Ranges do not have access to the type of productive subalpine habitat that is available in the Flathead River drainage. In other words, the synergistic effects of multiple BEC units are considered by modifying ratings by Ecosection where appropriate.

In 1996, the authors proposed a standardized step-down process for 5 individual human influences that influence grizzly bear carrying capacity: 1) direct habitat loss; 2) habitat alteration (e.g. logging); 3) habitat displacement or alienation (e.g. from motorized traffic on roads); 4) within-home range habitat fragmentation; and 5) human-caused mortality history. We proposed that regional staff estimate: a) the proportion of land affected; b) the degree of stepdown on the affected land (e.g. 100% for habitat loss such as a reservoir); and c) the relative habitat value of the affected land in that unit (e.g. relative to the average habitat available in the area).

To conduct the subjective stepdown process we advised and assisted regional staff to use of whatever inventories and maps they had available to them, including LANDSAT images, road maps, settlement and agricultural mapping and other relevant inputs. We also provided and suggested that kill statistics and plots of kill locations be examined to assist with mortality history stepdown. The process is more fully described by Austin (1998). Originally, stepdowns were made at the entire Management Unit (MU) level. For most regions we now apply stepdowns at finer strata. Typically individual rows in the stepdown spreadsheets are unique combinations of Grizzly Bear Population Unit (GBPUs), MU, permanent grizzly bear hunting closures, and Ecosection/BEC units (to the phase level in the BEC hierarchy).

Grizzly Bear Populations

In 1995 the Wildlife Program began identifying Grizzly Bear Population Units (GBPUs). GBPU lines are meant to identify similar behavioural ecotypes and sub-populations of bears. In the south, GBPU boundaries follow natural and human-caused fractures in grizzly bear distribution. There appears to be some degree of genetic isolation among these units (Procter et al. 2002). In northern and coastal British Columbia, GBPU boundaries follow natural and ecological boundaries or transition areas (primarily heights of land between watersheds) and less frequently follow actual barriers to grizzly bear movement.

The original GBPUs were drawn from an ecological perspective as advised by the former Grizzly Bear Scientific Advisory Committee (GBSAC 1997). However, this approach created numerous administrative problems, particularly for harvest management (e.g. when a single MU was in more than one GBPU). In 2000, GBPU lines, were largely reconciled to MU boundaries in areas where the difference was considered inconsequential from an ecological perspective resulting in a total of 60 GBPUs (Figure 4).

At the edges of grizzly bear distribution in the province, GBPU boundaries represent the "occupied" line. This line was carefully drawn to reflect the known and predicted distribution of resident adult females. Transient males, particularly subadults, are occasionally sighted outside the occupied line. However, these lines serve as the expected limits of the areas regularly inhabited by grizzly bears. GBPUs serve as the key units for population objective setting, and for determining allowable human-caused mortality thresholds. They are also used for setting land use priorities during strategic land use planning.

Population Inventory Techniques and Results

Grizzly bear population inventory has greatly improved since the 1990 estimate (Fuhr and Demarchi 1990). The Resources Inventory Committee (RIC) for the province published bear inventory standards in 1998 (RIC 1998). This comprehensive summary: 1) recommends the best methods for censusing populations of black bears and grizzly bears throughout British Columbia; and 2) provides protocols for these survey methods at different levels of intensity (i.e. presence/not detected, relative abundance, absolute abundance). Unfortunately, the DNA/Hair Collection/Mark Recapture methodology pioneered in British Columbia (Woods et al. 1999) was under development at the time. As a consequence, the RIC standards for bear inventory placed a relatively low emphasis on this technique and is now in need of revision based on the experience gained in recent years.

Rather than duplicate the extensive number of publications on DNA Mark-Recapture here, we refer the reader to the individual reports (Table 4) (Figure 5). We have made some use of these inventories in our current estimate. In some cases, current potential density assignments and stepdowns of individual Ecosection/BEC combinations have been changed to recognize the density estimates determined by inventory.

British Columbia
Grizzly Bear Population Units
2001
Threatened
Unoccupied
Viable
Never Occupied
Tatshenshini
Tagish
Cassiar
Taku
Hyland
Muskwa
Taiga
Rocky
Edziza
Spatsizi
Alta
Finlay-
Ospika
Lower
Stikine
Upper
Skeena-
Nass
Omineca
Moberly
Stewart
Cranberry
Babine
Hart
Kitlope-
Fiordland
Nation
Parsnip
North
Coast
Bulkley-
Lakes
Francois
Nulki
Bowron
Quesnel
Lake
North
Robson
Blackwater-
West Chilcotin
Wells
Gray
Tweedsmuir
Central
Rockies
Spillamacheen
North
Selkirk
Kwatna-
Owikeno
Klinaklini-
Homathko
Columbia-
Shuswap
Rockies
Park
Ranges
South
Chilcotin
Ranges
North
Purcell
Central
Monashee
Central
Purcell
South
Rockies
Toba-
Bute
Stein-
Nahatlatch
Valhalla
South
Purcell
Kettle-
Granby
South
Selkirk
Yahk
Flathead
Garibaldi-
Pitt
North
Cascades
Central
Selkirk
BRITISH
COLUMBIA

Figure 4

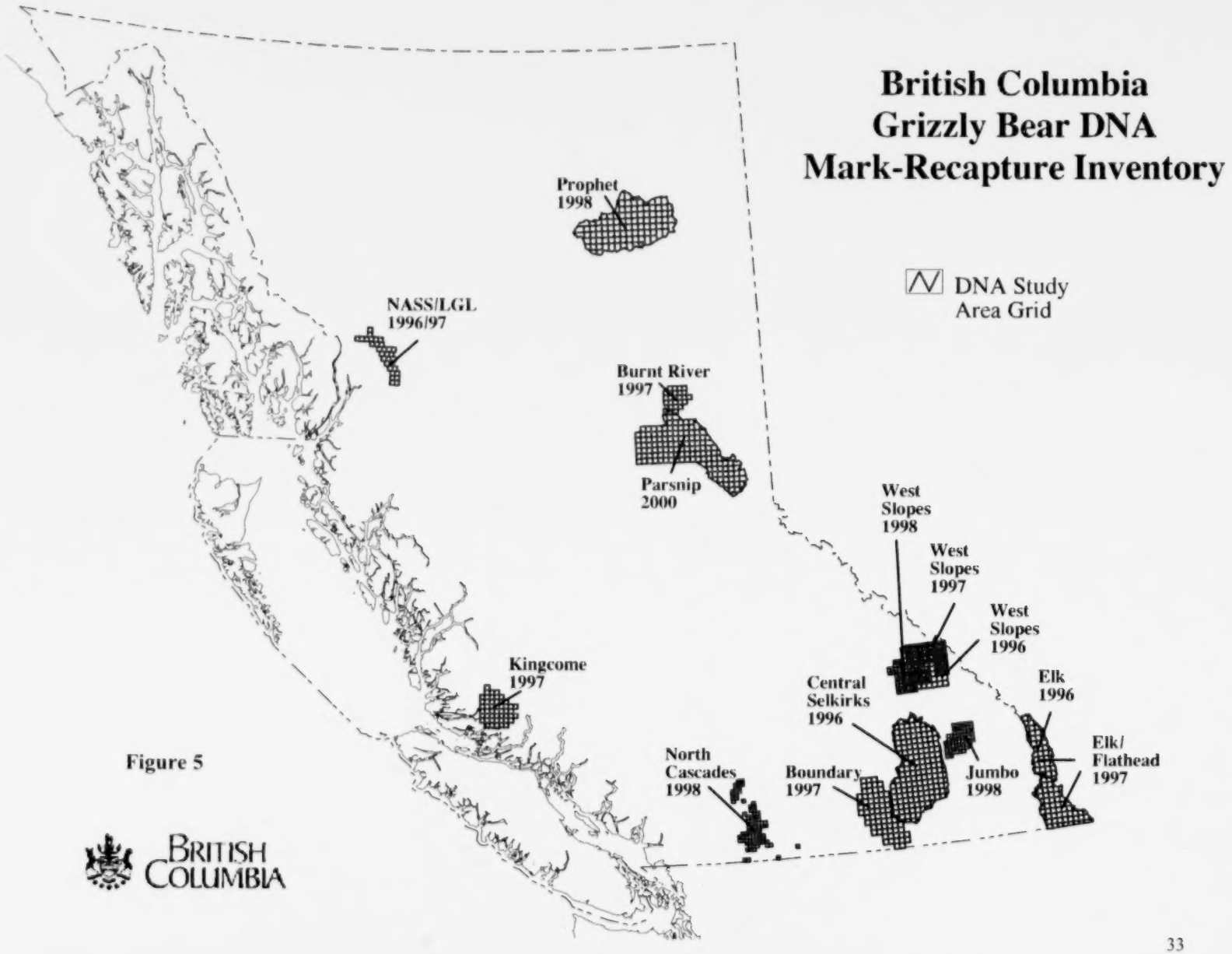

British Columbia
Grizzly Bear DNA
Mark-Recapture Inventory
DNA Study
Area Grid
Prophet
1998
NASS/LGL
1996/97
Burnt River
1997
Parsnip
2000
West
Slopes
1998
West
Slopes
1997
West
Slopes
1996
Kingcome
1997
Central
Selkirks
1996
Elk
1996
Elk/
Flathead
1997
North
Cascades
1998
Boundary
1997
Jumbo
1998
BRITISH
COLUMBIA

Figure 5

The relationship between the Fuhr-Demarchi/Stepdown derived estimates and the Mark-Recapture estimates for eight of the estimates from six study areas has also been examined (Boulanger and Hamilton 2002). In all but two cases (Kingcome and West Slopes 1998), the minimum estimate from the Fuhr-Demarchi/Stepdown method was greater than the inventory estimate. Regression results suggest that from the statistical perspective, inventory-based estimates were nearly identical to the Fuhr-Demarchi/Stepdown estimate (Boulanger and Hamilton 2002).

The largest discrepancy between inventory results and Fuhr-Demarchi/Stepdown estimates is in the Flathead River drainage study area. The estimated minimum density from Fuhr-Demarchi for that study area are 64 bears per 1,000km^2, and the inventory result was 48 bears/1,000km^2. However, this inventory was from much the same study area as the 80 bears per 1,000km^2 estimate from McLellan (1989, 1994). As a result, we suspect the Flathead inventory estimate is flawed. The recently completed Parsnip estimate (Mowat et al. 2002.) clearly demonstrates a Fuhr-Demarchi/Stepdown underestimate. As a consequence, the estimates presented for the Omineca subregion (Table 3) show current estimates greater than current potential. Revision of the capability estimates is required for this subregion.

Notwithstanding the capability error in the Omineca, we estimate the current minimum grizzly bear habitat potential at approximately 19,000 bears in the occupied habitat. The current minimum population (post-stepdown) is aproximately 14,000 animals (including cubs) (Table 3). As mentioned, we estimate the historic minimum estimate of grizzly bears in British Columbia was approximately 20,000 animals. When compared to the current minimum population estimate this represents a loss of approximately 35%. The nine GBPUs that are classed as "Threatened" (less than 50% of their current habitat potential) have a minimum estimate of 506 bears (4% of the provincial total).

Review of Current Legislation and Policy Governing Grizzly Bear Hunting

Under the Grizzly Bear Conservation Strategy (GBCS) all grizzly bear hunting in British Columbia has been placed under management by Limited Entry Hunting (LEH) for residents and Guide Outfitter Quotas (GOQ) for non-residents as of fall, 1996 (Ministry of Environment, Lands and Parks 1995). This change only affected northern British Columbia as southern areas of the province had already been managed on this basis for, in some cases, in excess of 20 years.

Under the LEH system, resident hunters apply to a lottery for an authorization to hunt grizzly bears in a specific LEH Zone. An LEH Zone is usually either a partial or whole Management Unit, however, in a few cases LEH Zones encompass all or portions of more than one Management Unit (Figure 6).

Non-residents must be accompanied by a licensed Guide Outfitter when hunting big game, including grizzly bears. Each Guide Outfitter has an exclusive Guide Outfitter Area and, must have a quota assigned by the Regional Fish, Wildlife and Habitat Manager or the Director of the Wildlife Branch in order to guide hunters for grizzly bears.

The annual bag limit for grizzly bears is one. It is illegal to hunt grizzly bears in British Columbia by placing bait or using a dead animal or part of it as bait. It is legal to use dogs to hunt grizzly bears, however, this technique is rarely, if ever, used. It is also illegal for a hunter to kill a grizzly bear less than two years old, or any bear in its company. Grizzly bear hunting is closed in all national parks and some provincial parks (Figure 6).

In southern areas of British Columbia, except for the coast, grizzly bear hunting is limited to spring seasons beginning on April 1 and ending between May 31 and June 10 depending on the area (Figure 7). In northern and coastal areas of the province grizzly bear hunting occurs during both spring seasons that open April 1 – 15 and close on May 31 – June 15 and fall seasons that open August 15 – October 1 and close October 25 – November 30.

Grizzly bears occupy 89% of their historic range in British Columbia and have been extirpated from the remaining 11% which coincides with the major concentrations of private land as well as the directly related highest densities of roads and of human population (Figure 4). The areas that grizzly bears have been extirpated from are no longer considered to be suitable for supporting them due to habitat impacts and the risk of conflicts. In terms of the entire province, grizzly bears currently occupy 84% of the province and historically occupied 94%.

Grizzly bear hunting is closed indefinitely in 24%, and temporarily in another 13%, of the species' historic range in British Columbia (Figure 7). Of the remaining 63% of the historic range, 50% has both spring and fall hunting seasons and 13% has only spring hunting seasons.

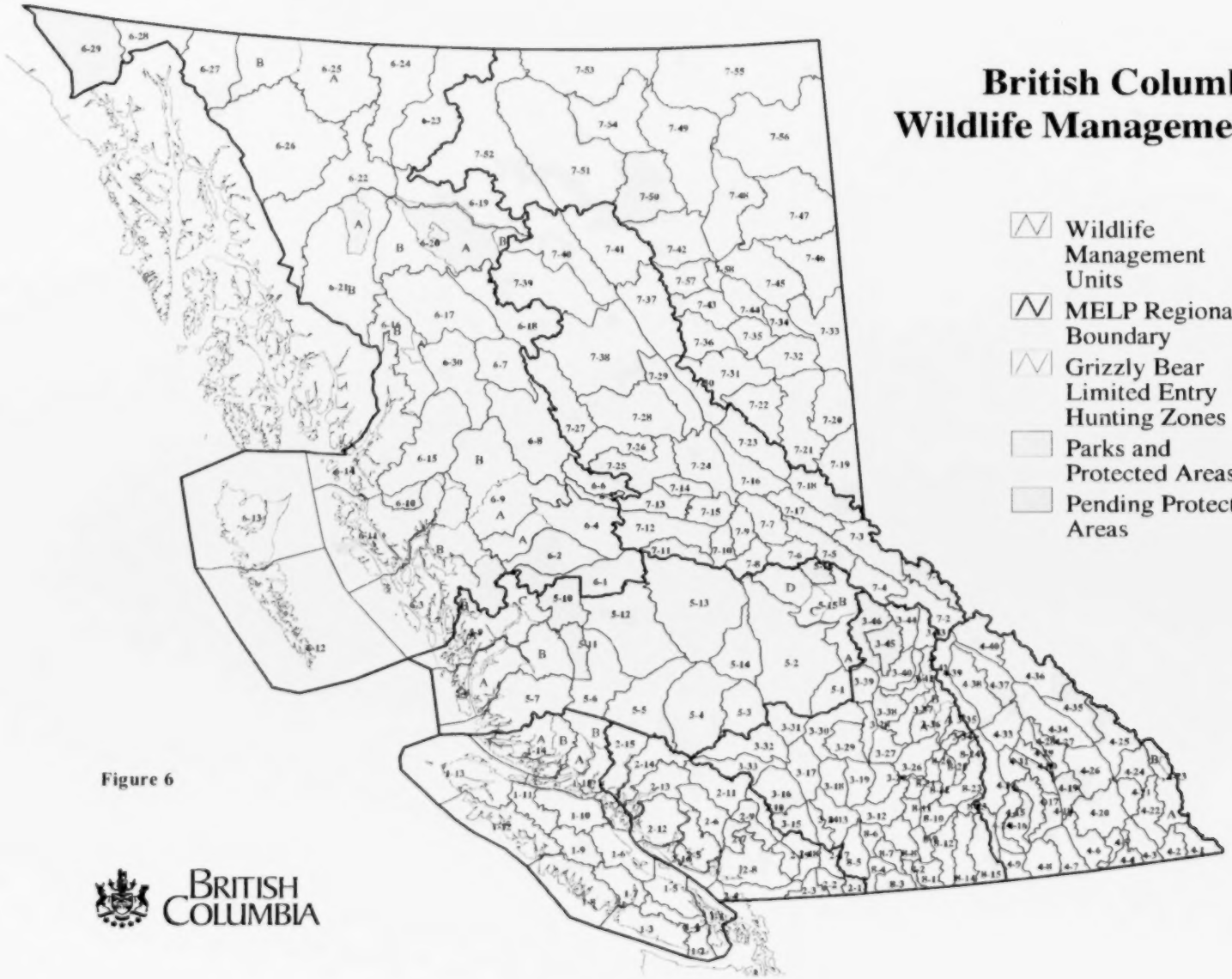


Figure 6

BRITISH COLUMBIA

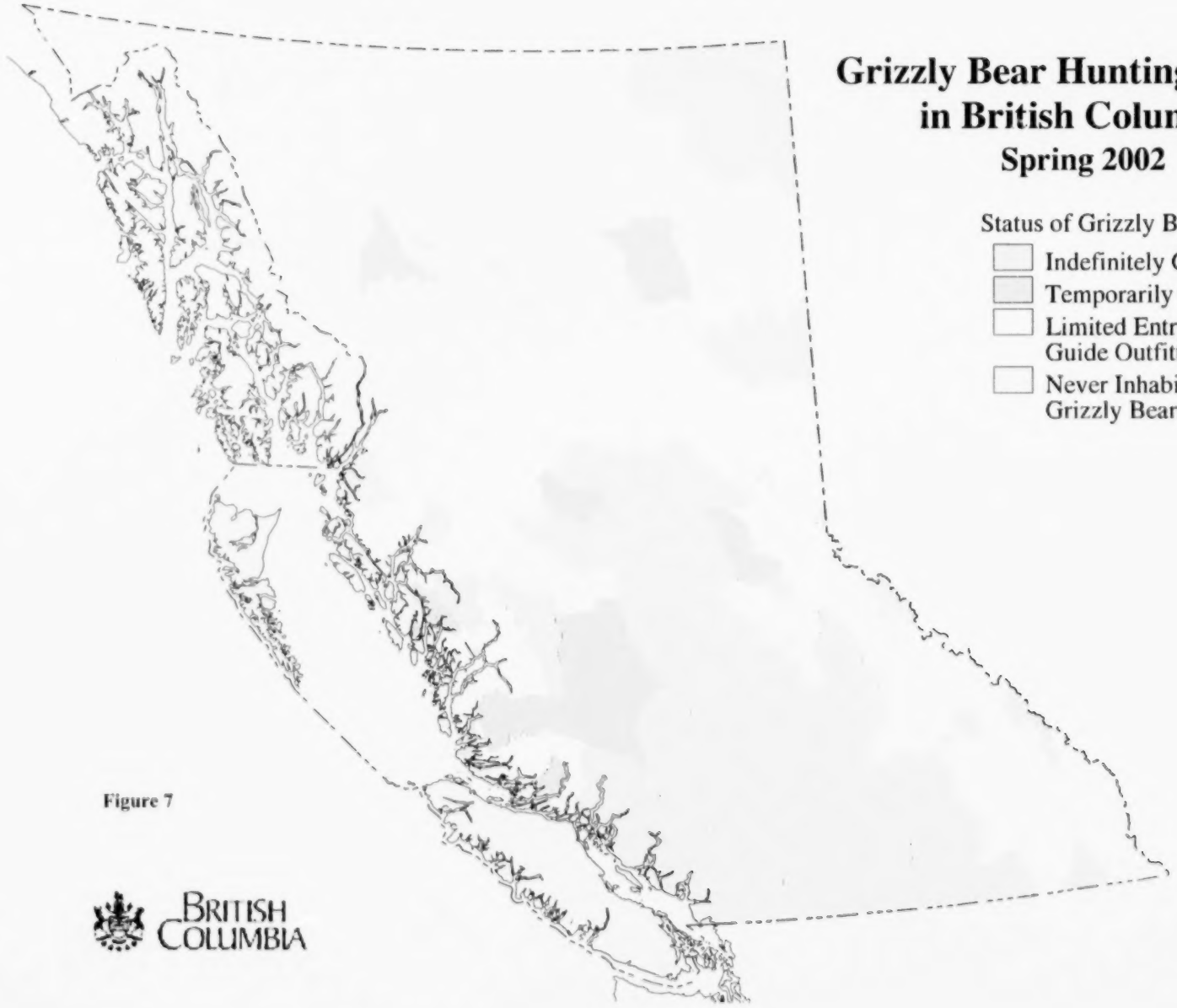

Grizzly Bear Hunting Seasons
in British Columbia
Spring 2002
Status of Grizzly Bear Hunting
Indefinitely Closed
Temporarily Closed
Limited Entry and
Guide Outfitter Hunting
Never Inhabited by
Grizzly Bears
BRITISH
COLUMBIA

Figure 7

Any grizzly bear harvested must be brought to a provincial government office for Compulsory Inspection which includes confirmation of sex, extraction of a tooth for ageing and recording the date and location of the kill as well as the hunter's name. In some cases tissue or hair samples are also taken for DNA analysis.

Grizzly bears are listed under Appendix II of the Convention on the Trade in Endangered Species (CITES) and as a result a CITES permit is required to export a grizzly bear or grizzly bear parts from Canada. Under the provincial *Wildlife Act* it is an offence to possess, traffic in, import or export bear galls, including any part or derivative of the gall bladder, and genitalia. It is also illegal to trade in bear paws separated from the carcass or hide, although possession of bear paws is still permitted to allow for personal use and for ceremonial use by aboriginal people.

In addition to the GBCS the other policy document with relevance to grizzly bear harvest is the Wildlife Harvest Strategy (WHS) (Ministry of Environment, Lands and Parks 1996). The WHS states that harvest must not impair the sustainability of any hunted species, that harvest prescriptions must be based on scientific principles, that these prescriptions must also be sufficiently conservative to allow for uncertainty in population estimates and that the harvests of Blue-listed species and subspecies will be particularly cautious to ensure conservation. Specifically with respect to grizzly bears the WHS states that "the conservation of grizzly bears and their habitats will supersede all other activities related to harvest management" and "Grizzly bears will be harvested only where hunting will not jeopardize population sustainability."

Finally, in addition to the GBCS and WHS, the Grizzly Bear Harvest Procedure was approved in October, 1999 and outlines specifically how grizzly bear harvests are to be administered (Appendix 1). A detailed spreadsheet and accompanying guide have been prepared to facilitate the calculations necessary to comply with this procedure as well as to serve as the form for submitting Annual Allowable Harvests and recommendations for Limited Entry Hunting seasons to the Wildlife Branch for review (Appendix 2).

Overview of the Grizzly Bear Harvest Management Procedure

The process of determining sustainable harvest levels for grizzly bears begins with the development of a population estimate for the LEH Zone(s) and Grizzly Bear Population Unit (GBPU) in question. GBPUs are groupings of LEH Zones that constitute a reasonably distinct population or sub-population of grizzly bears and serve as the foundation for grizzly bear conservation and management.

Population estimates are derived either directly from population inventories or indirectly through the Fuhr-Demarchi method (see above). For harvest purposes the low end of the Fuhr-Demarchi range is normally used (with an adequate rationale a higher value within the range can be used but this is unusual) and for sound inventories the population estimate minus the standard deviation of the estimate is used. Populations that are <50% of the estimated habitat capability for the GBPU are designated as "threatened" and are closed to grizzly bear hunting. Any areas >100 km^2 within an open LEH Zone that are closed to grizzly bear hunting are excluded from harvest calculations and do not contribute to the area's population estimate for harvest purposes.

Once a population estimate has been prepared the maximum annual allowable total human caused mortality rate is determined. This is based on a sliding scale between 3 and 6% and is linked directly to the average habitat capability of the contributing habitats (i.e. the habitats that are assigned ratings of capability densities >0 bears/1,000 km^2) within the LEH Zone (Figure 8). The maximum end of the scale (6%) is consistent with the available literature on sustainable levels of human-caused mortality (Bunnell and Tait 1981, Harris 1986, Miller 1990, Hovey and McLellan 1996). The sliding scale is based on the principle that the lower the average habitat capability, the lower the productivity of the area and therefore the lower the rate of human mortality that the population is capable of sustaining (Eberhardt 1990, McLellan 1994).

In order to address the issue of unknown human caused mortality (e.g. undetected poaching, crippling loss during legal hunting, unreported road and train kills or grizzly-bear human conflicts, etc.), an estimate of the annual rate of loss to these unknown human causes is deducted from the total allowable human caused mortality to arrive at the maximum annual known human caused mortality rate. Estimates for unreported human-caused mortality rates normally used range from 1% – 2% of the population annually based on advice provided to the provincial government by the Grizzly Bear Scientific Advisory Committee (GBSAC 1998). The rate estimated for each area is then multiplied against the population estimate to determine the actual number of grizzly bears that can be lost to all known human causes (hunting and non-hunting) in any given year. Translocations of grizzly bears outside of a GBPU are also treated as mortalities since these animals are effectively lost from these populations.

In some areas with a history of known non-hunting human caused mortality (e.g. grizzly bear-human conflicts) an estimate of the rate of loss from this source can also be made and incorporated into the process. This estimate will usually be based on an average of the actual annual mortalities from this source.

Before the harvest available in the current allocation period can be established an analysis of the known human caused mortality for the previous allocation period must be conducted to resolve whether or not there was an overkill of either total grizzly bears or females. This determination is reached by deducting the actual known human caused total and female mortality from the allowable levels. Any negative balances are carried forward and deducted from what would otherwise be available during the current allocation period. Note that overkills are not normally be carried forward unless they have occurred for the GBPU as a whole and that only the net overkill for the GBPU is carried forward. Positive harvest balances are not carried forward between allocation periods.

Allowable female mortality is calculated and tracked separately because limiting human caused female mortality is critical to the long-term viability of grizzly bear populations. The maximum level specifically for known human caused female mortality is set at 30% of the maximum known human-caused mortality level for both sexes combined (Harris 1986).

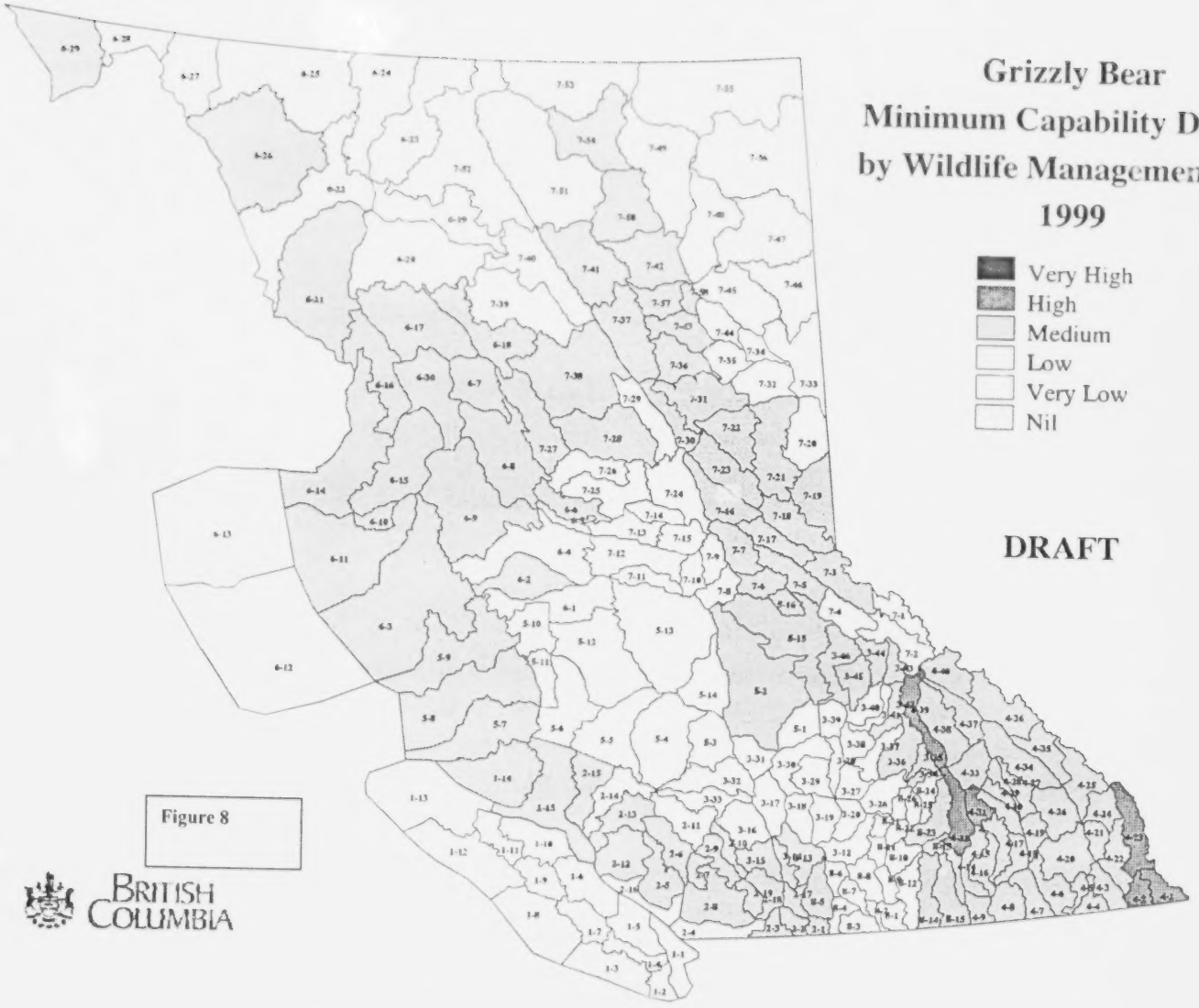


Figure 8

BRITISH COLUMBIA

The calculation of the known human caused mortality balance that is available for harvest during the current allocation period follows the same general process as described for the previous allocation period. One exception is that if an estimate of known non-hunting human caused mortality has been made, this annual rate is multiplied by the length of the allocation period (usually 3 years) and that value in turn is multiplied against the population estimate of the LEH Zone to determine the estimated number of grizzly bears that will be lost to these non-hunting human causes during the current allocation period. This estimate is deducted from the maximum allowable known human caused mortality for the current allocation period to arrive at the maximum allowable harvest.

The advantage of including an estimate of known non-hunting human caused mortality for areas where such losses are likely to occur is that it avoids the risk that the occurrence of these mortalities will force managers to restrict hunting opportunities during the allocation period in order to avoid exceeding the maximum allowable known human caused mortality level. If known non-hunting human caused mortalities are lower than estimated, increased hunting opportunities can be provided toward the end of the allocation period.

Once the allowable harvest balance and known human caused female mortality balance for the current allocation period have been calculated, the unused allocations for non-residents and First Nations are calculated in order to determine what portion of the harvest balance is available for residents. This involves deducting the unused portion of any allocations to non-residents and First Nations from the harvest balance to arrive at the allowable harvest balance available for residents for the current allocation period. A portion of this balance is then allocated to the specific hunting season in question based primarily on the remaining number of hunting seasons (e.g. if there are two hunting seasons remaining during the current allocation period the resident allocation for the next season might be half of the allowable harvest balance for residents).

The number of LEH authorizations available in a given area is calculated based on the desired harvest by residents for the hunting season in question. Since only a fraction of resident hunters that are drawn to hunt grizzly bears are successful, the desired resident harvest is divided by the proportion of hunters that are successful in the specific area in question based on the average over the previous three years. In order to minimize the risk of a dramatic change in success rates unduly impacting mortality levels, a minimum success rate of 10% has been set for LEH. As a result, no more than 10 LEH authorizations will be issued for each animal to be harvested (this is in despite of the fact that in some areas success rates are below 10%).

The last step in this process is for the wildlife managers involved to formally recommend the number of LEH authorizations that they believe should be issued. This number may vary considerably from the number calculated simply by dividing the desired resident harvest by the success rate (almost always lower) due to professional opinion based on concerns over female mortality levels, anecdotal information on population trends etc.

This description is based on the assumption that the population objective for the GBPUs for which allowable mortality and harvest levels are being calculated, is to maintain the current population. It is also possible, however, for population objectives to be set that seek to increase a population or to allow it to decline to a lower level (although no population objective will be set that would allow a population to become threatened which is defined as <50% of habitat capability). When the objective is to allow the population to increase, the maximum annual

allowable total human caused mortality rate may be set below the level that would otherwise be applied (e.g. 4% instead of 6%).

When the population objective for a GBPU allows for the population to decline, some or all mortality from known non-hunting human causes may be deducted from the population estimate and these would then not be counted toward the allowable mortality level for the GBPU. An objective that allows for a
population decline will normally only be set for areas where there is a history of chronic high levels of grizzly bear-human conflicts and where it has been established that these conflicts are linked to size of the grizzly bear population as opposed to human factors such as poor management of attractants. In the absence of a specific objective to increase or decrease the size of a population, the default objective for all grizzly bear populations is to maintain the current level of abundance.

Harvest Analysis – Provincial Overview

There has been a requirement in British Columbia for hunters to bring any grizzly bear they harvest to a provincial government office for inspection since 1976. All non-hunting mortalities including illegal kills, animal control kills, roadkills etc. have also been tracked through the same system. A premolar is removed from inspected animals for ageing (Stoneberg and Jonkel 1966, Craighead et al. 1970). As a result, there is detailed information available on mortality levels, hunter effort and success, the age and sex of animals killed, kill location and kill type for the period since 1978. The quality of the data for the first two years of Compulsory Inspection (1976 – 1977) are believed to be poor and have been excluded from this analysis.

Grizzly bear hunting in British Columbia is not managed on the basis of any trends or desired harvest characteristics (aside from mortality levels) in the age/sex of the animals killed as these indicators are not considered to be sufficiently reliable as a basis for management (Harris and Metzgar 1987). In many cases the same trend can be used to suggest that a population is increasing or declining as a result of overharvest (Caughley 1974, Bunnell and Tait 1980). Instead of relying on harvest trends that may provide a false sense of security, this information is only used on an ad hoc basis to identify areas where trends in the age and/or sex of animals harvested may indicate excessive mortality. Most commonly action is taken to reduce hunting opportunities in response to conservation concerns without regard to these indicators.

Mortality and harvest analysis at the provincial level that combines mortality from the 60 GBPUs in the province and different management regimes (i.e. areas with spring only seasons as well as those with both spring and fall hunts) is particularly problematic. Analyses for individual populations or groups of populations is more appropriate for detecting potential conservation issues. Due to serious reservations regarding the biological significance of any results, statistical tests or analyses aside from descriptive statistics have not been applied in this analysis. Emphasis is placed on comparing the four years prior to the implementation of province wide LEH in the fall of 1996 (1992 – 1995) with the four years following (1997 – 2000).

Total Known Mortality and Kill Types

Human-caused grizzly bear mortalities are categorized into for four kill types: Hunting, Animal Control, Illegal and Pick-up. Pick-up kills include road and train kills as well as any grizzly bears found dead of unknown causes (in some cases these may be natural mortalities). For the

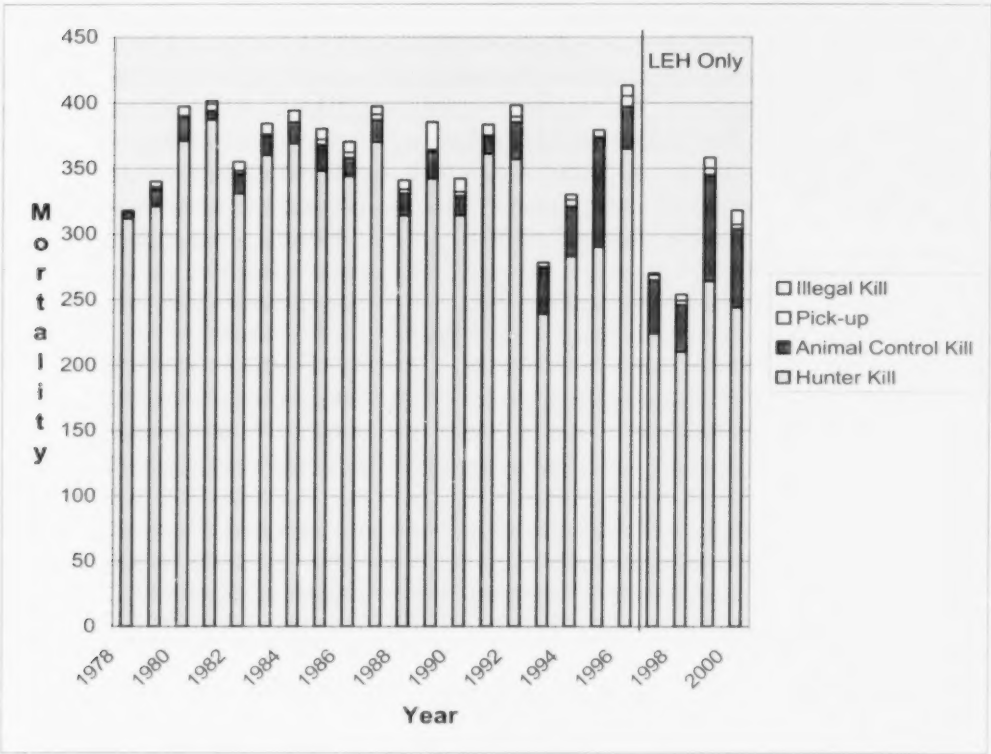
23 year period from 1978 – 2000 there were a total of 8,185 grizzly bears recorded killed by all kill types (Table 6, Figure 9). An average of 356 grizzly bear mortalities have been recorded annually through the

Compulsory Inspection system ranging from 254 (in 1998) to 413 (in 1996). Of those mortalities, 89% were from hunting, 8% from animal control, 1% from pick-up and 2% from illegal kills. Hunter harvest averaged 336 grizzly bears annually for 1978 – 1996 compared to 236 for 1997 – 2000. For 1992 – 1995, the four years prior to the transition year in 1996 when province wide LEH was implemented for the fall, the average hunter harvest was 292 grizzly bears annually. It should be noted that a number of areas have been closed either indefinitely or temporarily to grizzly bear hunting during the 1997 – 2000 period which partially accounts for any changes in the hunter harvest.

Table 6: Grizzly Bear Mortality by Kill Type, 1978-2000

Year	Hunter Kill	Animal Control Kill	Pick-up	Illegal Kill	Total
1978	312	6	0	0	318
1979	321	13	2	4	340
1980	371	19	0	7	397
1981	387	7	5	2	401
1982	331	15	2	7	355
1983	360	15	1	8	384
1984	369	16	0	9	394
1985	348	20	4	8	380
1986	344	14	4	8	370
1987	370	17	4	6	397
1988	314	17	3	7	341
1989	342	21	1	21	385
1990	314	15	3	10	342
1991	361	13	1	8	383
1992	357	28	4	9	398
1993	239	35	1	3	278
1994	283	38	5	4	330
1995	290	83	1	5	379
1996	365	32	8	8	413
1997	224	41	4	1	270
1998	210	36	3	5	254
1999	264	81	5	8	358
2000	244	60	3	11	318
Total	**7,320**	**642**	**64**	**159**	**8,185**

Figure 9: Provincial Grizzly Bear Mortality by Kill Type by Year, 1978-2000



Animal control kills have averaged 28 grizzly bears annually for 1978 – 2000, ranging from six (in 1978) to 83 (in 1995). It is suspected that the low level of animal control kills in the late 1970s and early 1980s may reflect problems with reporting. For the four years prior to the implementation of province wide LEH (1992 – 1995) the average annual animal control kill was 46 grizzly bears compared to 55 for 1997 – 2000. Increases in animal control kills in the mid-1990s can be linked directly to electro-fencing of landfills around the province to deny bears access to garbage and to thereby reduce bear/human conflicts over the long term (Ciarniello 1997).

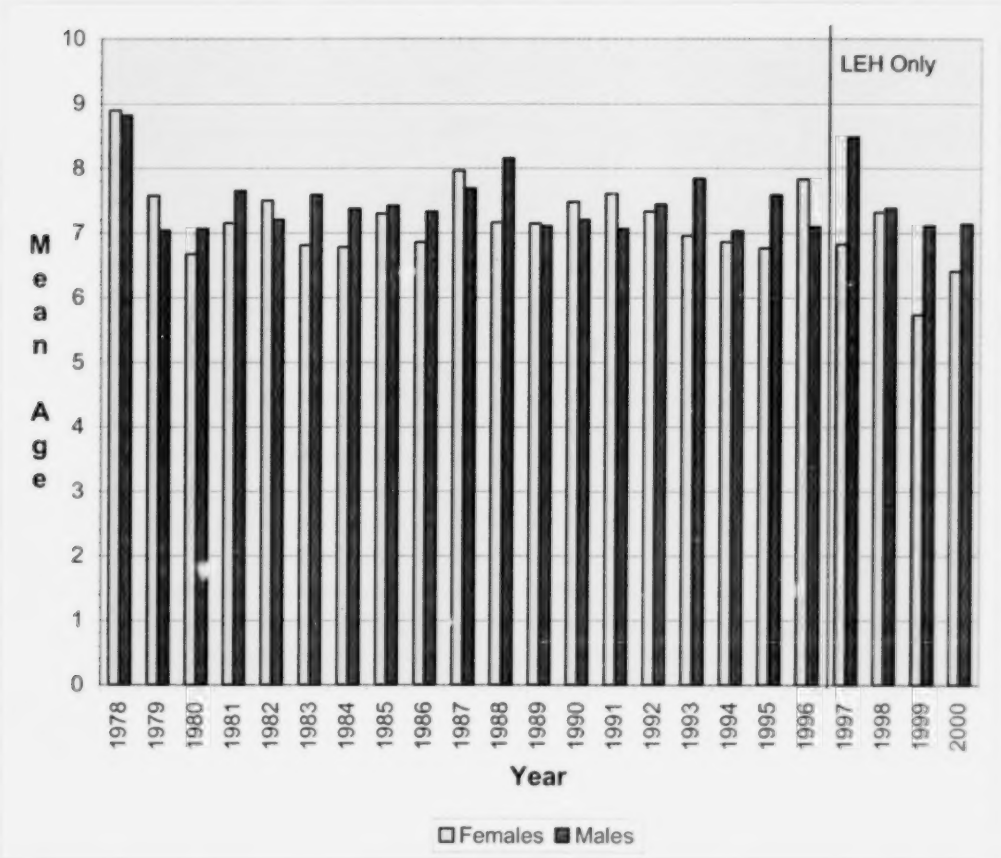
Average Age by Sex

Of the 7,320 grizzly bears taken by hunters from 1978 – 2000, age is available for 6,569 or 90%. The average age of female and male grizzly bears in the hunter harvest was 7.0 and 7.5 years respectively for 1992 – 1995 and 6.6 and 7.5 respectively for 1997 – 2000 following the implementation of province wide LEH (Table 7). There are no trends evident in the average age of hunter harvested grizzly bears from 1978 – 2000 aside from a small potential drop in the average age of females that coincided with the implementation of province wide LEH (Figure 10).

Table 7: Mean Age of Grizzly Bears Taken by Hunters by Year, 1978-2000

Year	Females	Males
1978	8.9	8.8
1979	7.6	7.0
1980	6.7	7.1
1981	7.2	7.7
1982	7.5	7.2
1983	6.8	7.6
1984	6.8	7.4
1985	7.3	7.4
1986	6.9	7.3
1987	8.0	7.7
1988	7.2	8.1
1989	7.1	7.1
1990	7.5	7.2
1991	7.6	7.1
1992	7.3	7.4
1993	7.0	7.8
1994	6.9	7.0
1995	6.8	7.6
1996	7.8	7.1
1997	6.8	8.5
1998	7.3	7.4
1999	5.7	7.1
2000	6.4	7.1

Figure 10: Provincial Grizzly Bear Harvest Mean Age by Sex by Year, 1978 - 2000



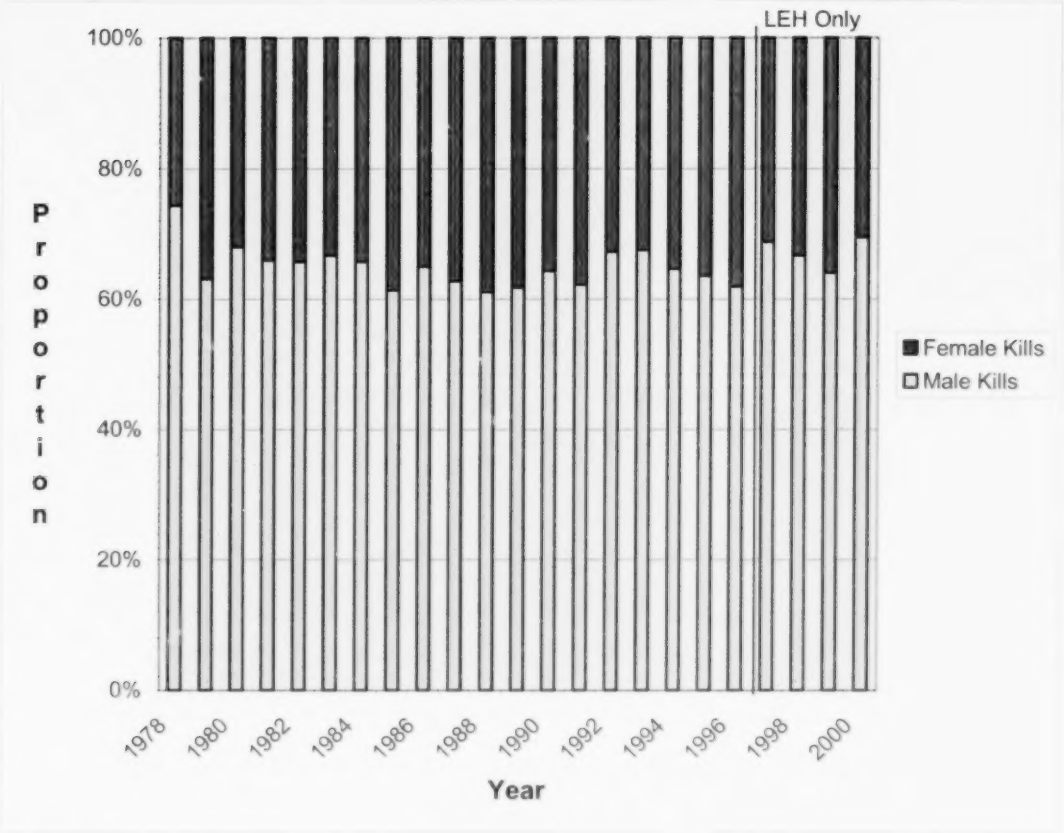
Female Hunter Harvest

Of the 7,320 grizzly bears taken by hunters from 1978 – 2000, sex is available for 7,256 or 99% (Table 8). The proportion of females in the hunter harvest averaged 34.3% for 1992 – 1995 and 32.8% for 1997 – 2000 following the implementation of province wide LEH. There are no trends evident in the proportion by sex of hunter harvested grizzly bears from 1978 – 2000 aside from the small apparent change that coincided with the implementation of province wide LEH (Figure 11). With the exception of 1978 in which the data on the sex of harvested grizzly bears is considered less reliable, the hunter harvest has consistently exceeded 30% female.

Table 8: Sex of Grizzly Bears Taken by Hunters by Year, 1978-2000

Year	Male	Female	Total	% Male	% Female
1978	226	78	304	74.3%	25.7%
1979	200	117	317	63.1%	36.9%
1980	249	117	366	68.0%	32.0%
1981	250	129	379	66.0%	34.0%
1982	215	112	327	65.7%	34.3%
1983	238	119	357	66.7%	33.3%
1984	240	125	365	65.8%	34.2%
1985	211	133	344	61.3%	38.7%
1986	223	120	343	65.0%	35.0%
1987	231	137	368	62.8%	37.2%
1988	190	121	311	61.1%	38.9%
1989	210	130	340	61.8%	38.2%
1990	200	111	311	64.3%	35.7%
1991	222	135	357	62.2%	37.8%
1992	240	117	357	67.2%	32.8%
1993	160	77	237	67.5%	32.5%
1994	181	99	280	64.6%	35.4%
1995	183	105	288	63.5%	36.5%
1996	226	139	365	61.9%	38.1%
1997	154	70	224	68.8%	31.3%
1998	140	70	210	66.7%	33.3%
1999	169	95	264	64.0%	36.0%
2000	168	74	242	69.4%	30.6%
Total	**4,726**	**2,530**	**7,256**	**65.1%**	**34.9%**

Figure 11: Provincial Grizzly Bear Harvest by Sex by Year

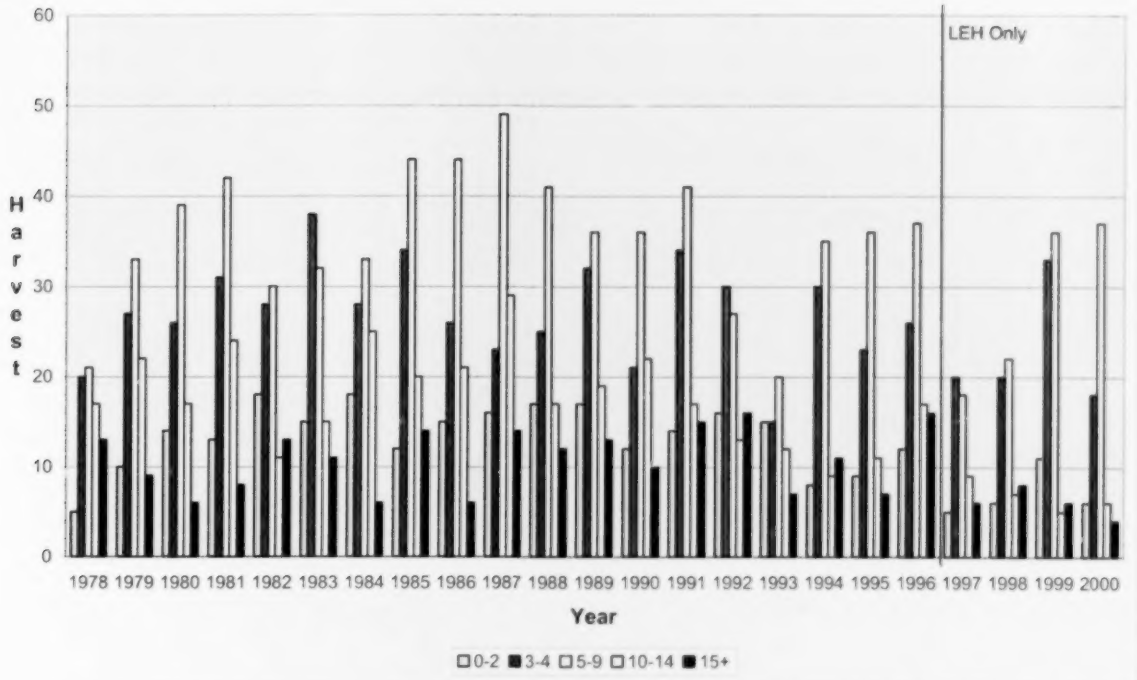


During the period from 1978 – 2000, the break-down of the female grizzly bear hunter harvest by year has followed a relatively consistent trend where the level of harvest increased through the first three age classes (0-2, 3-4 and 5-9 years old) and then declined through the last two age classes (10-14 and 15+ years old) (Table 9, Figure 12).

Table 9: Provincial Female Grizzly Bear Harvest by Age Class by Year, 1978 - 2000

Year	0-2	3-4	5-9	10-14	15+
1978	5	20	21	17	13
1979	10	27	33	22	9
1980	14	26	39	17	6
1981	13	31	42	24	8
1982	18	28	30	11	13
1983	15	38	32	15	11
1984	18	28	33	25	6
1985	12	34	44	20	14
1986	15	26	44	21	6
1987	16	23	49	29	14
1988	17	25	41	17	12
1989	17	32	36	19	13
1990	12	21	36	22	10
1991	14	34	41	17	15
1992	16	30	27	13	16
1993	15	15	20	12	7
1994	8	30	35	9	11
1995	9	23	36	11	7
1996	12	26	37	17	16
1997	5	20	18	9	6
1998	6	20	22	7	8
1999	11	33	36	5	6
2000	6	18	37	6	4

Figure 12: Provincial Female Grizzly Bear Harvest by Age Class by Year, 1978 - 2000



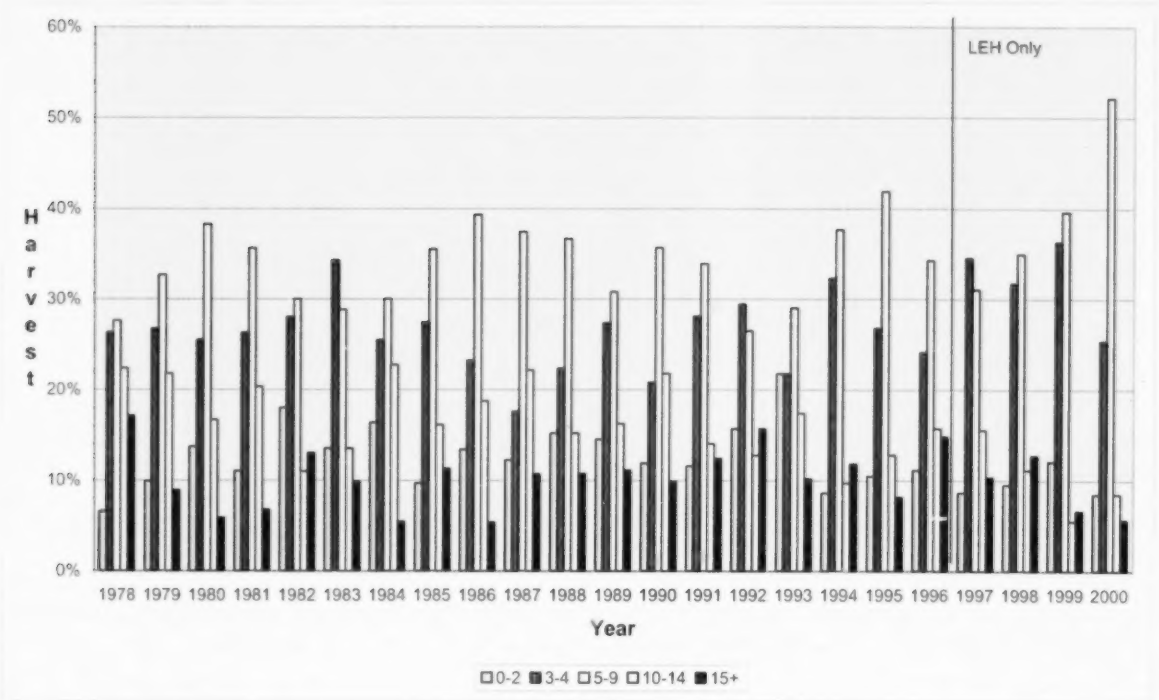
There were eight years that varied slightly from that general trend: 1982, 1983, 1992 – 1994 and 1997 – 1999. In five of these eight years (1982, 1992, 1994, 1998 and 1999) more female grizzly bears were harvested from the fifth age class (15+ years old) than from the fourth age class (10 – 14 years old). In three of the years (1983, 1992 and 1997) the number of female grizzly bears harvested in the second age class (3-4 years old) exceeded the number harvested in the third age class (5-9 years old). In one year (1993) the number of female grizzly bears harvested in the first age class (0-2 years old) equalled the number harvested in the second age class (3-4 years old).

The proportion of the female component of the grizzly bear harvest that has come from each of the five age classes has changed in recent years (Table 10, Figure 13). For the four years (1992 – 1995) prior to the implementation of province wide LEH in 1996, the hunter harvest of females averaged 14% from age class 1 (0-2 years old) compared to 10% for 1997 – 2000. For age class 2 (3-4 years old) and 3 (5-9 years old) combined, the proportion of the female harvest averaged 61% from 1992 – 1995 compared to 71% for 1997 – 2000. The proportion of female grizzly bear harvest from age class four (10-14 years old) and five (15+ years old) combined averaged 25% from 1992 – 1995 compared to 19% for 1997 – 2000. The net result of this is that a greater proportion of the female harvest came from age class two and three and lower proportions from the other three age classes in 1997 – 2000 following the implementation of province wide LEH. Aside from this shift, there are no obvious trends in the proportion of females harvested by age class.

Table 10: Proportion of Provincial Female Grizzly Bear Harvest by Age Class by Year, 1978 – 2000

Year	0-2	3-4	5-9	10-14	15+
1978	6.6%	26.3%	27.6%	22.4%	17.1%
1979	9.9%	26.7%	32.7%	21.8%	8.9%
1980	13.7%	25.5%	38.2%	16.7%	5.9%
1981	11.0%	26.3%	35.6%	20.3%	6.8%
1982	18.0%	28.0%	30.0%	11.0%	13.0%
1983	13.5%	34.2%	28.8%	13.5%	9.9%
1984	16.4%	25.5%	30.0%	22.7%	5.5%
1985	9.7%	27.4%	35.5%	16.1%	11.3%
1986	13.4%	23.2%	39.3%	18.8%	5.4%
1987	12.2%	17.6%	37.4%	22.1%	10.7%
1988	15.2%	22.3%	36.6%	15.2%	10.7%
1989	14.5%	27.4%	30.8%	16.2%	11.1%
1990	11.9%	20.8%	35.6%	21.8%	9.9%
1991	11.6%	28.1%	33.9%	14.0%	12.4%
1992	15.7%	29.4%	26.5%	12.7%	15.7%
1993	21.7%	21.7%	29.0%	17.4%	10.1%
1994	8.6%	32.3%	37.6%	9.7%	11.8%
1995	10.5%	26.7%	41.9%	12.8%	8.1%
1996	11.1%	24.1%	34.3%	15.7%	14.8%
1997	8.6%	34.5%	31.0%	15.5%	10.3%
1998	9.5%	31.7%	34.9%	11.1%	12.7%
1999	12.1%	36.3%	39.6%	5.5%	6.6%
2000	8.5%	25.4%	52.1%	8.5%	5.6%

Figure 13: Proportion of Provincial Female Grizzly Bear Harvest by Age Class by Year, 1978 - 2000

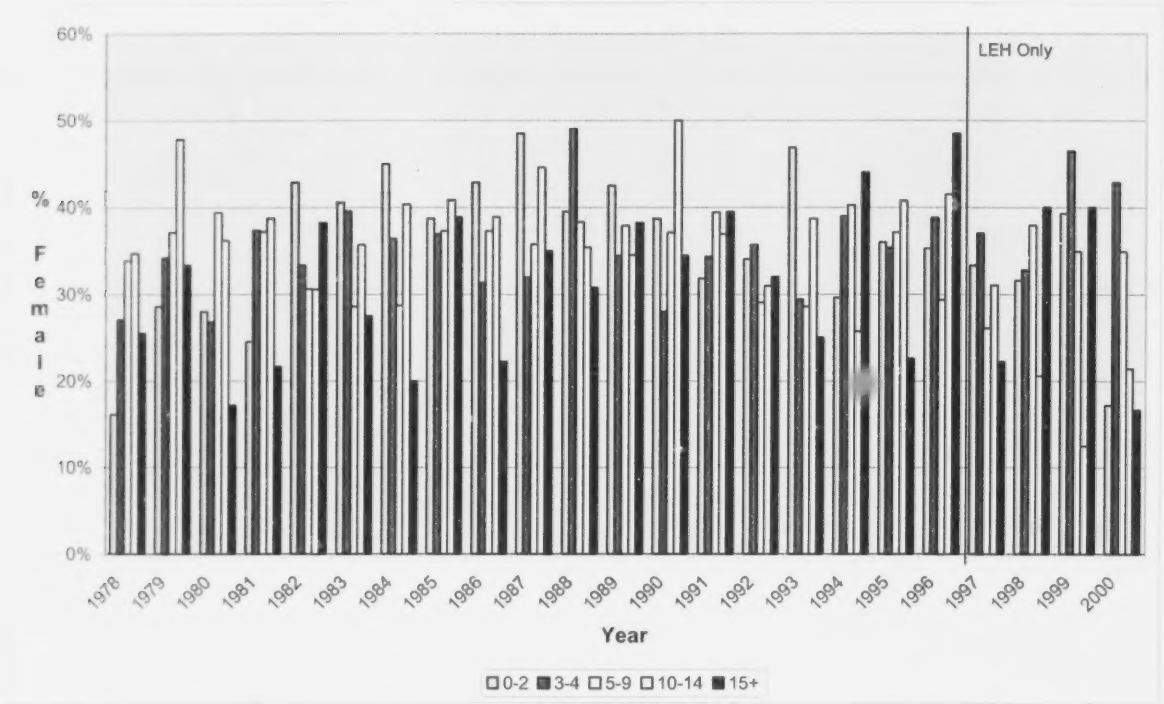


Of hunter harvested grizzly bears, the proportion of females within each age class has shown considerable variation (Table 11, Figure 14). For 1992 – 1995, the proportion of females in age class 1-5 averaged 37%, 35%, 34%, 34% and 31% respectively – a declining proportion of females in older age classes. In comparison, for 1997 – 2000, the proportion of females in age class 1-5 averaged 30%, 40%, 33%, 21% and 30% respectively – a lower proportion of females in age class 1 and 4 and a higher proportion in age class 2.

Table 11: Proportion of Harvested Female Grizzly Bears within Age Classes by Year, 1978 – 2000

Year	0-2	3-4	5-9	10-14	15+
1978	16.1%	27.0%	33.9%	34.7%	25.5%
1979	28.6%	34.2%	37.1%	47.8%	33.3%
1980	28.0%	26.8%	39.4%	36.2%	17.1%
1981	24.5%	37.3%	37.2%	38.7%	21.6%
1982	42.9%	33.3%	30.6%	30.6%	38.2%
1983	40.5%	39.6%	28.6%	35.7%	27.5%
1984	45.0%	36.4%	28.7%	40.3%	20.0%
1985	38.7%	37.0%	37.3%	40.8%	38.9%
1986	42.9%	31.3%	37.3%	38.9%	22.2%
1987	48.5%	31.9%	35.8%	44.6%	35.0%
1988	39.5%	49.0%	38.3%	35.4%	30.8%
1989	42.5%	34.4%	37.9%	34.5%	38.2%
1990	38.7%	28.0%	37.1%	50.0%	34.5%
1991	31.8%	34.3%	39.4%	37.0%	39.5%
1992	34.0%	35.7%	29.0%	31.0%	32.0%
1993	46.9%	29.4%	28.6%	38.7%	25.0%
1994	29.6%	39.0%	40.2%	25.7%	44.0%
1995	36.0%	35.4%	37.1%	40.7%	22.6%
1996	35.3%	38.8%	29.4%	41.5%	48.5%
1997	33.3%	37.0%	26.1%	31.0%	22.2%
1998	31.6%	32.8%	37.9%	20.6%	40.0%
1999	39.3%	46.5%	35.0%	12.5%	40.0%
2000	17.1%	42.9%	34.9%	21.4%	16.7%

Figure 14: Proportion of Harvested Female Grizzly Bears within Age Classes by Year, 1978 – 2000



Male Hunter Harvest

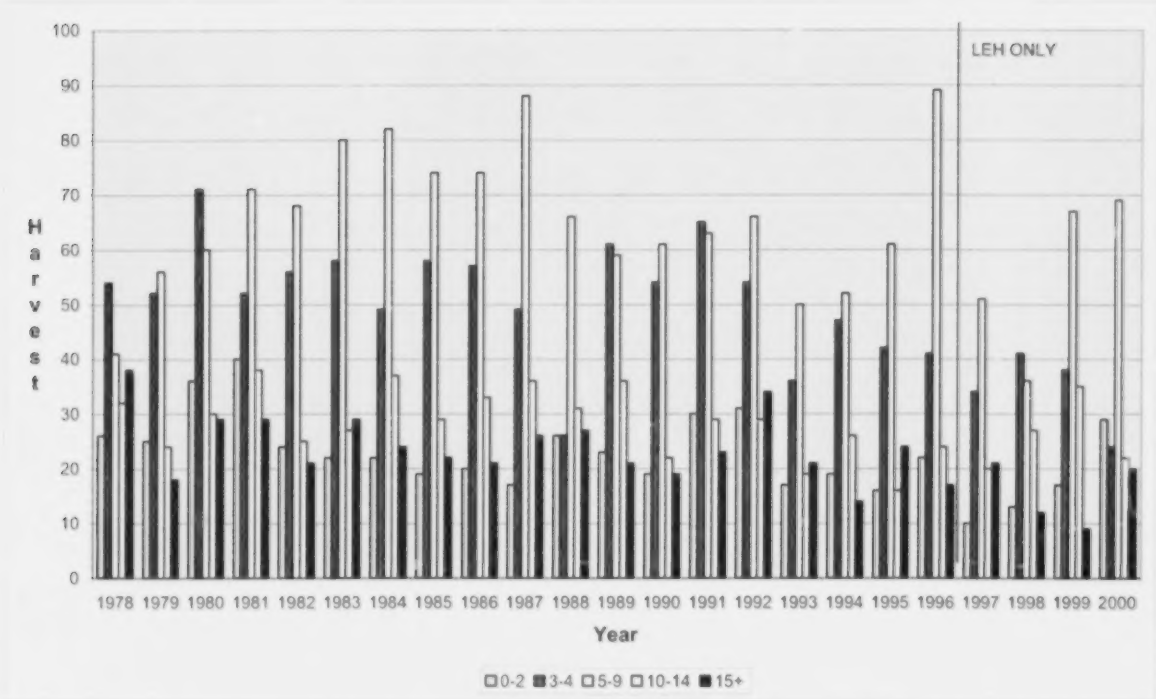
As with females, the hunter harvest of male grizzly bears from 1978 – 2000 has also followed a general trend in which the level of harvest increased through the first three age classes (0-2, 3-4 and 5-9 years old) and then declined through the last two age classes (10-14 and 15+ years old) (Table 12, Figure 15).

There were twelve years that varied from this general trend: 1978, 1980, 1983, 1988, 1989, 1991 – 1993, 1995, 1997, 1998 and 2000. In six years (1983, 1992, 1993, 1995 and 1997) age class 5 (15+ years old) equalled or exceeded age class four (10-14 years old). In six years (1978, 1980, 1988, 1989, 1991 and 1998) age class two (3-4 years old) equalled or exceeded age class three (5-9 years old). In one year (2000) age class 1 (0-2 years old) exceeded age class 2 (3-4 years old). Note that 1978 was the only year that varied from the general trend for two of the above reasons.

Table 12: Provincial Male Grizzly Bear Harvest by Age Class by Year, 1978 – 2000

Year	0-2	3-4	5-9	10-14	15+
1978	26	54	41	32	38
1979	25	52	56	24	18
1980	36	71	60	30	29
1981	40	52	71	38	29
1982	24	56	68	25	21
1983	22	58	80	27	29
1984	22	49	82	37	24
1985	19	58	74	29	22
1986	20	57	74	33	21
1987	17	49	88	36	26
1988	26	26	66	31	27
1989	23	61	59	36	21
1990	19	54	61	22	19
1991	30	65	63	29	23
1992	31	54	66	29	34
1993	17	36	50	19	21
1994	19	47	52	26	14
1995	16	42	61	16	24
1996	22	41	89	24	17
1997	10	34	51	20	21
1998	13	41	36	27	12
1999	17	38	67	35	9
2000	29	24	69	22	20

Figure 15: Provincial Male Grizzly Bear Harvest by Age Class by Year, 1978 - 2000

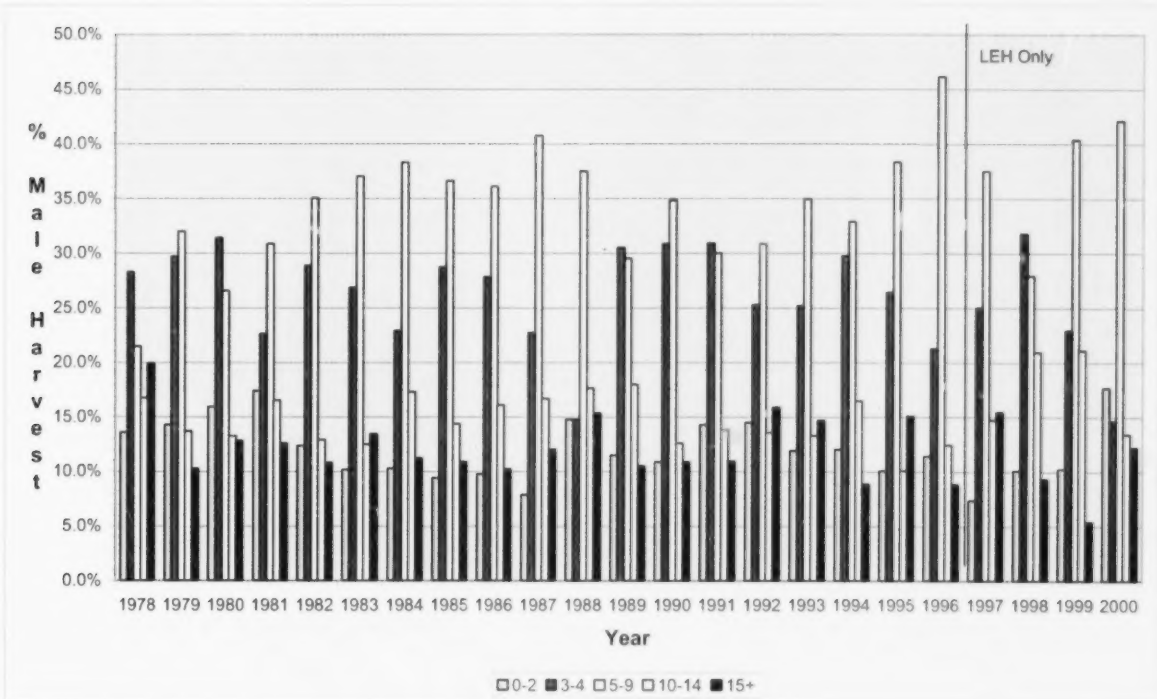


The proportion of male grizzly bear harvest that has come from each of the five age classes has changed in recent years (Table 13, Figure 16). For the four years (1992 – 1995) prior to the implementation of province wide LEH in 1996 the hunter harvest of males averaged 12%, 27%, 34%, 13% and 14% for age class 1-5 respectively. For the four years (1997 – 2000) following the implementation of province wide LEH the hunter harvest of males averaged 11%, 24%, 37%, 18% and 11% for age class 1-5 respectively. In a similar fashion as with females, the implementation of province wide LEH coincided with a greater proportion of harvested males being from age class 3 and 4 and lower proportions from the other three age classes. Aside from this small shift, there are no obvious trends in the proportion of males harvested by age class.

Table 13: Proportion of Provincial Male Grizzly Bear Harvest by Age Class by Year, 1978 - 2000

Year	0-2	3-4	5-9	10-14	15+
1978	13.6%	28.3%	21.5%	16.8%	19.9%
1979	14.3%	29.7%	32.0%	13.7%	10.3%
1980	15.9%	31.4%	26.5%	13.3%	12.8%
1981	17.4%	22.6%	30.9%	16.5%	12.6%
1982	12.4%	28.9%	35.1%	12.9%	10.8%
1983	10.2%	26.9%	37.0%	12.5%	13.4%
1984	10.3%	22.9%	38.3%	17.3%	11.2%
1985	9.4%	28.7%	36.6%	14.4%	10.9%
1986	9.8%	27.8%	36.1%	16.1%	10.2%
1987	7.9%	22.7%	40.7%	16.7%	12.0%
1988	14.8%	14.8%	37.5%	17.6%	15.3%
1989	11.5%	30.5%	29.5%	18.0%	10.5%
1990	10.9%	30.9%	34.9%	12.6%	10.9%
1991	14.3%	31.0%	30.0%	13.8%	11.0%
1992	14.5%	25.2%	30.8%	13.6%	15.9%
1993	11.9%	25.2%	35.0%	13.3%	14.7%
1994	12.0%	29.7%	32.9%	16.5%	8.9%
1995	10.1%	26.4%	38.4%	10.1%	15.1%
1996	11.4%	21.2%	46.1%	12.4%	8.8%
1997	7.4%	25.0%	37.5%	14.7%	15.4%
1998	10.1%	31.8%	27.9%	20.9%	9.3%
1999	10.2%	22.9%	40.4%	21.1%	5.4%
2000	17.7%	14.6%	42.1%	13.4%	12.2%

Figure 16: Proportion of Provincial Male Grizzly Bear Harvest by Age Class by Year, 1978 - 2000



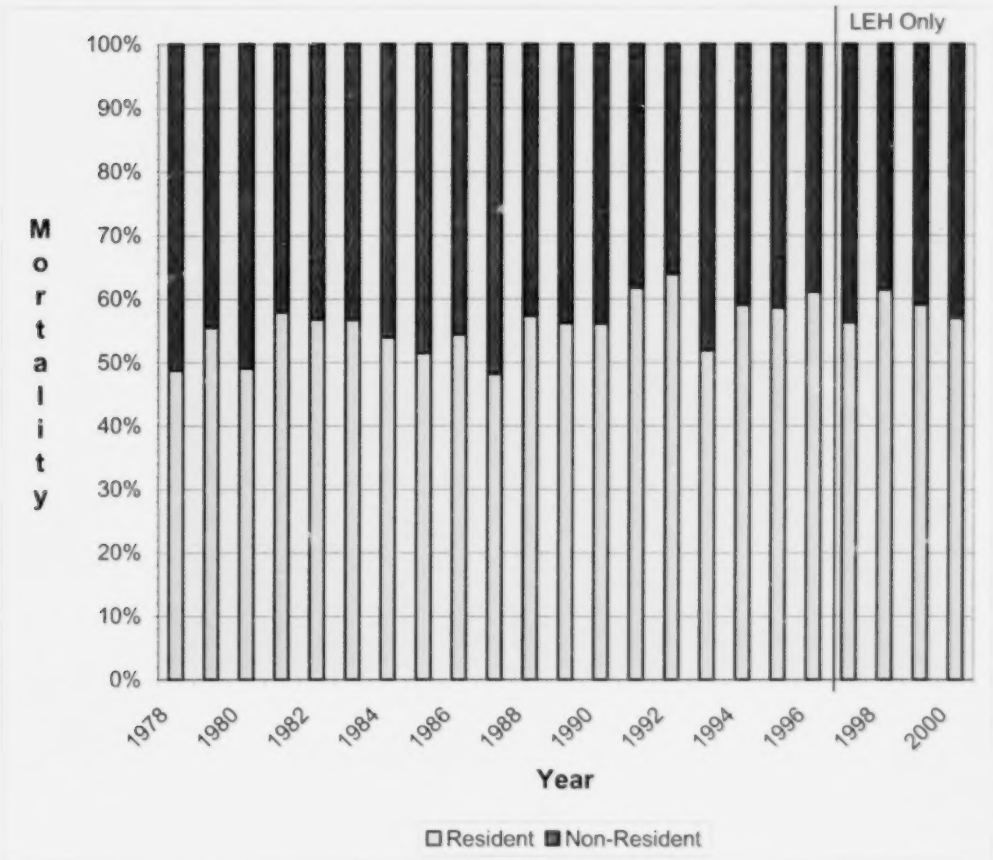
Hunter Harvest by Residency Group

The proportion of harvested grizzly bears taken by resident hunters has increased during the 1978 – 2000 period (Table 14, Figure 17). Resident hunters accounted for 53% of the grizzly bear harvest from 1978 – 1981 compared to 58% from 1997 – 2000. This reflects changes in the allocation of hunting opportunities to resident and non-resident hunters during this time.

Table 14: Proportion of Grizzly Bear Hunting Mortality by Resident vs Non-Resident by Year, 1978 - 2000

Year	Resident	Non-Resident
1978	48.7%	51.3%
1979	55.5%	44.5%
1980	49.1%	50.9%
1981	57.9%	42.1%
1982	56.8%	43.2%
1983	56.7%	43.3%
1984	53.9%	46.1%
1985	51.4%	48.6%
1986	54.4%	45.6%
1987	48.1%	51.9%
1988	57.3%	42.7%
1989	56.1%	43.9%
1990	56.1%	43.9%
1991	61.8%	38.2%
1992	63.9%	36.1%
1993	51.9%	48.1%
1994	59.0%	41.0%
1995	58.6%	41.4%
1996	61.1%	38.9%
1997	56.3%	43.8%
1998	61.4%	38.6%
1999	59.1%	40.9%
2000	57.0%	43.0%

Figure 17: Proportion of Grizzly Bear Hunting Mortality by Resident vs Non-Resident by Year, 1978 - 2000



Resident harvest of grizzly bears from 1978 – 2000 has ranged from 122 (in 1993) to 228 (in 1992) (Table 15). In the four years following the implementation of province wide LEH the resident harvest has averaged 137/year. This was the lowest four year average for this 23 year period. Non-resident grizzly bear harvest has ranged from 81 (in 1998) to 192 (in 1987). Non-resident hunter harvest averaged of 98/year for 1997 – 2000. As with resident hunters, this was also the lowest four year average for this 23 year period.

Table 15: Provincial Resident and Non-Resident Grizzly Bear Harvest by Sex by Year, 1978 - 2000

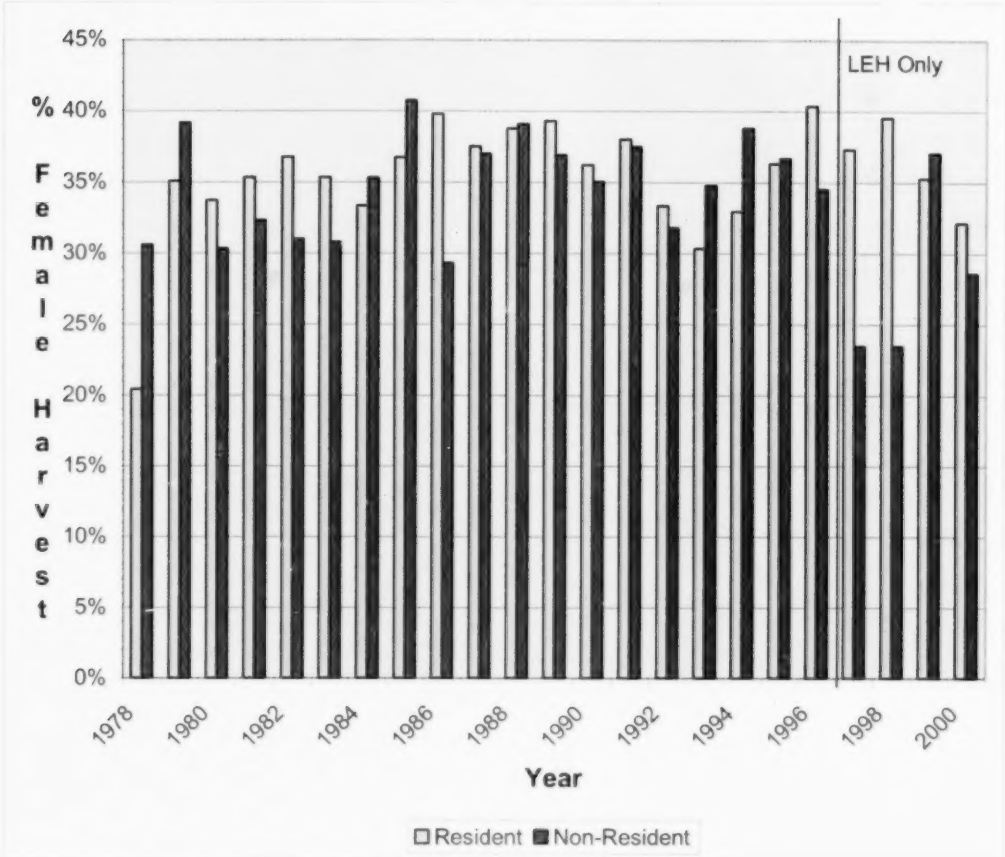
Year	Resident			Non-Resident		
	Female	Male	Total	Female	Male	Total
1978	30	117	147	48	109	157
1979	61	113	174	56	87	143
1980	60	118	178	57	131	188
1981	77	141	218	52	109	161
1982	68	117	185	44	98	142
1983	71	130	201	48	108	156
1984	65	130	195	60	110	170
1985	65	112	177	68	99	167
1986	74	112	186	46	111	157
1987	66	110	176	71	121	192
1988	69	109	178	52	81	133
1989	75	116	191	55	94	149
1990	63	111	174	48	89	137
1991	84	137	221	51	85	136
1992	76	152	228	41	88	129
1993	37	85	122	40	75	115
1994	54	110	164	45	71	116
1995	61	107	168	44	76	120
1996	90	133	223	49	93	142
1997	47	79	126	23	75	98
1998	51	78	129	19	62	81
1999	55	101	156	40	68	108
2000	44	93	137	30	75	105

Aside from 1978 when the data on the sex of harvested grizzly bears is believed to be less reliable, the percentage of female grizzly bears in the resident hunter harvest has varied between 30% (in 1993) and 40% (in 1996) (Table 16). The average percentage of female grizzly bears in the resident harvest for the four years prior to the implementation of province wide LEH (1992 – 1995) was 33% and was 36% for 1997 – 2000. There are no obvious trends in the sex ratio of resident grizzly bear harvest aside from a possible small increase in the percentage of females that coincided with the implementation of provide wide LEH (Figure 18).

Table 16: Proportion of Resident Grizzly Bear Harvest by Sex by Year, 1978 - 2000

Year	Female		Male		Total
1978	30	20.4%	117	79.6%	147
1979	61	35.1%	113	64.9%	174
1980	60	33.7%	118	66.3%	178
1981	77	35.3%	141	64.7%	218
1982	68	36.8%	117	63.2%	185
1983	71	35.3%	130	64.7%	201
1984	65	33.3%	130	66.7%	195
1985	65	36.7%	112	63.3%	177
1986	74	39.8%	112	60.2%	186
1987	66	37.5%	110	62.5%	176
1988	69	38.8%	109	61.2%	178
1989	75	39.3%	116	60.7%	191
1990	63	36.2%	111	63.8%	174
1991	84	38.0%	137	62.0%	221
1992	76	33.3%	152	66.7%	228
1993	37	30.3%	85	69.7%	122
1994	54	32.9%	110	67.1%	164
1995	61	36.3%	107	63.7%	168
1996	90	40.4%	133	59.6%	223
1997	47	37.3%	79	62.7%	126
1998	51	39.5%	78	60.5%	129
1999	55	35.3%	101	64.7%	156
2000	44	32.1%	93	67.9%	137

Figure 18: Provincial Percentage of Female Grizzly Bears Harvested by Residents and Non-Residents by Year, 1978 - 2000



The percentage of female grizzly bears in the non-resident hunter harvest has varied between 23% (in 1997 and 1998) and 41% (in 1985) (Table 17). The average percentage of female grizzly bears in the non-resident harvest for the four years prior to the implementation of province wide LEH (1992 – 1995) was 36% and declined to 28% for 1997 – 2000. Three of the four years in which less than 30% of the non-resident harvest was comprised of females occurred within the four years following the implementation of province wide LEH. Aside from the reduction in the proportion of females that coincided with the implementation of province wide LEH, there are no obvious trends in the sex ratio of the non-resident grizzly bear harvest.

Table 17: Proportion of Non-Resident Grizzly Bear Harvest by Sex by Year, 1978 - 2000

Year	Female		Male		
1978	48	30.6%	109	69.4%	157
1979	56	39.2%	87	60.8%	143
1980	57	30.3%	131	69.7%	188
1981	52	32.3%	109	67.7%	161
1982	44	31.0%	98	69.0%	142
1983	48	30.8%	108	69.2%	156
1984	60	35.3%	110	64.7%	170
1985	68	40.7%	99	59.3%	167
1986	46	29.3%	111	70.7%	157
1987	71	37.0%	121	63.0%	192
1988	52	39.1%	81	60.9%	133
1989	55	36.9%	94	63.1%	149
1990	48	35.0%	89	65.0%	137
1991	51	37.5%	85	62.5%	136
1992	41	31.8%	88	68.2%	129
1993	40	34.8%	75	65.2%	115
1994	45	38.8%	71	61.2%	116
1995	44	36.7%	76	63.3%	120
1996	49	34.5%	93	65.5%	142
1997	23	23.5%	75	76.5%	98
1998	19	23.5%	62	76.5%	81
1999	40	37.0%	68	63.0%	108
2000	30	28.6%	75	71.4%	105

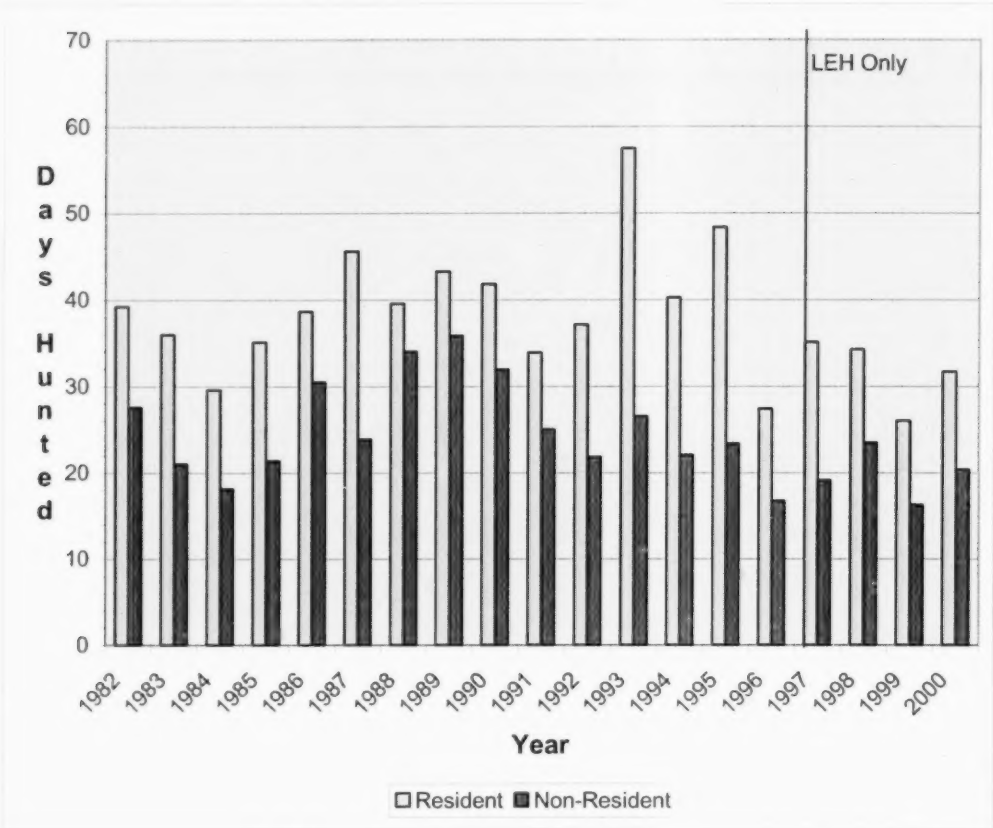
Hunter Success

The average number of days hunted for each grizzly bear harvested by resident hunters from 1982 – 2000 has ranged between 26 (in 1999) and 57 (in 1993) and has consistently been higher than that of non-resident hunters (Table 18, Figure 19). The average number of days/kill for residents was 46 for 1992 – 1995 and fell to 32 for 1997 – 2000.

Table 18: Mean Days/Kill for Resident and Non-Resident Hunters by Year, 1982 – 2000

Year	Resident	Non-Resident
1982	39.2	27.6
1983	36.0	21.0
1984	29.6	18.1
1985	35.1	21.3
1986	38.6	30.5
1987	45.6	23.8
1988	39.6	34.0
1989	43.3	35.9
1990	41.8	31.9
1991	33.9	25.0
1992	37.1	21.8
1993	57.5	26.5
1994	40.2	22.0
1995	48.3	23.4
1996	27.4	16.7
1997	35.1	19.1
1998	34.2	23.5
1999	26.0	16.3
2000	31.7	20.4

Figure 19: Mean Days/Kill for Resident and Non-Resident Hunters by Year, 1982 – 2000



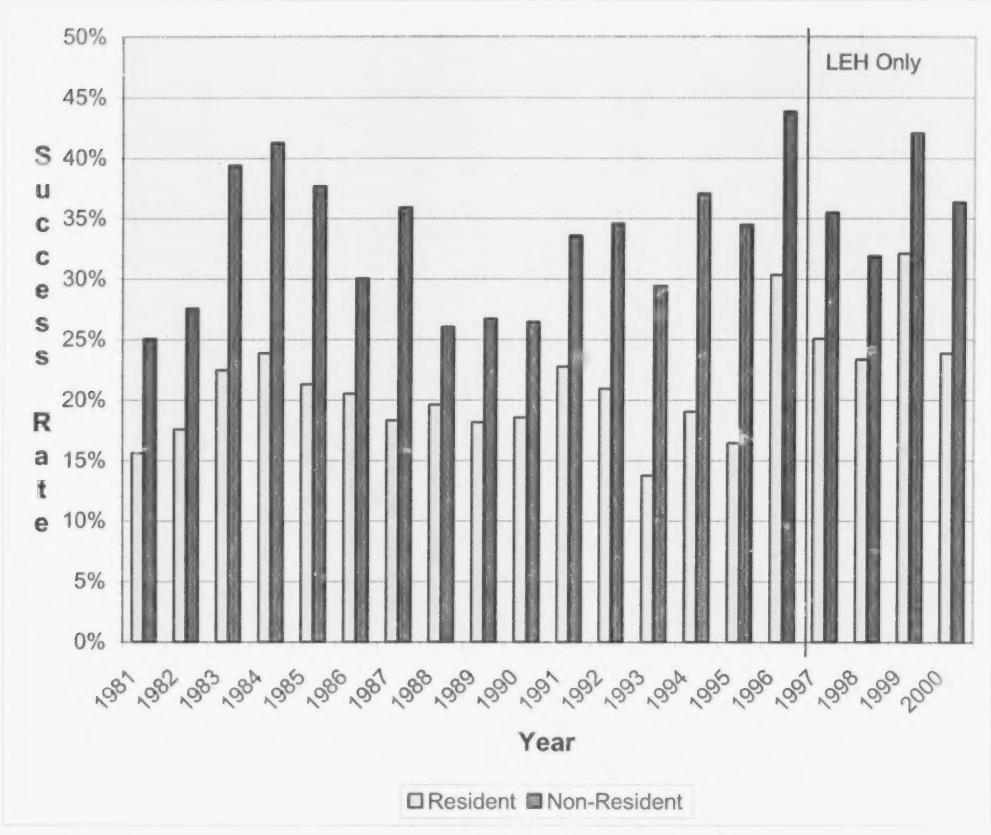
A similar pattern is seen for non-resident hunters where, for the period from 1982 – 2000, the average number of days hunted for each grizzly bear harvested has ranged between 16 (in 1999) and 36 in 1989. The average number of days/kill was 23 for 1992 – 1995 and fell to 20 in 1997 – 2000.

Resident hunter success rate from 1981 – 2000 has ranged from 14% (in 1993) to 32% (in 1999) (Table 19, Figure 20). The average resident success rate for 1992 – 1995 was 18% compared to 26% for 1997 – 2000. Non-resident hunter success has ranged from 25% (in 1981) to 44% in 1996. The average non-resident success rate for 1992 – 1995 was 34% compared to 36% for 1997 – 2000.

Table 19: Success Rate for Resident and Non-Resident Grizzly Bear Hunters, 1981 - 2000

Year	Resident	Non-Resident
1981	15.6%	25.0%
1982	17.6%	27.6%
1983	22.4%	39.4%
1984	23.9%	41.3%
1985	21.3%	37.6%
1986	20.5%	30.0%
1987	18.3%	35.9%
1988	19.6%	26.0%
1989	18.1%	26.7%
1990	18.5%	26.4%
1991	22.8%	33.6%
1992	20.9%	34.6%
1993	13.7%	29.4%
1994	19.0%	37.1%
1995	16.4%	34.5%
1996	30.3%	43.8%
1997	25.0%	35.5%
1998	23.3%	31.9%
1999	32.1%	42.0%
2000	23.8%	36.3%

Figure 20: Success Rate for Resident and Non-Resident Grizzly Bear Hunters, 1981 - 2000



Literature Cited

Banci, V. 1991. The status of Grizzly Bears in Canada in 1990. COSEWIC Status Report. 171p.

Barbeau, Marius. 1946. Bear Mother. Journal of American Folklore. Volume 59, Number 231. 20p.

Bandy, P.J. 1964. Game Biologist, Fish and Game Branch, Vancouver. Letter to a member of the public.

Belyea, B. (ed.) 1994. Columbia journals – David Thompson. McGill-Queen's University Press. Montreal. 336 p.

Blower, D. 1977. Population estimates for April 1977 Grizzly Bear map. Fish and Wildlife Branch. Victoria. 1p.

Boulanger, J. 2000. Granby-Kettle/Boundary Forest District 1997 Grizzly Bear DNA mark-recapture inventory project: Statistical analysis and population estimates. Wildlife Branch, Ministry of Environment, Lands and Parks. Victoria. 64 p.

Boulanger, J. 2001a. Analysis of the 1997 Elk Valley and Flathead Valley DNA mark-recapture Grizzly Bear Inventory Projects – 2001 Revision. Wildlife Branch, Ministry of Environment, Lands and Parks. Victoria. 43p.

Boulanger, J. 2001b. Estimates of the Grizzly Bear (*Ursus arctos*) population size using DNA based mark-recapture, Upper Columbia River, British Columbia, Canada 1996-1998. Upper Columbia River Bear Research Project c/o Mount Revelstoke and Glacier National Parks, Revelstoke, B.C. 34 p.

Boulanger, J. and S. Himmer. 2001. Kingcome (1997) DNA mark-recapture Grizzly Bear inventory project. Final Report. B.C. Ministry of Environment, Lands and Parks. Naniamo. 83p.

Boulanger, J. and A.N. Hamilton. 2002. A comparison of DNA mark-recapture and Fuhr-Demarchi / stepdown population and density estimates for grizzly bears in British Columbia. Biodiversity Branch, Ministry of Water, Land and Air Protection. Victoria. 17p.

Bunnell, F.L., and D.E.N. Tait. 1980. Bears in models and reality – implications to management. pp. 15-23 *in* C.J. Martinka and K.L. McArthur eds., Dynamics of Large Mammal Populations. Wiley Press. 416pp.

Byun, S.A. 1997. North American Black Bear MTDNA phylogeography: implications for morphology and the Haida Gwaii glacial refugium controversy. Evolution 51(5):1647-1653

Caughley, G. 1974. Interpretation of age ratios. Journal of Wildlife Management 38(3):557-562.

Ciarniello, L.M. 1997. Reducing human-bear conflicts:solutions through better management of non-natural foods. Report prepared for: Ministry of Environment, Lands & Parks, Victoria, British Columbia, Canada. 139pp.

Clague, J.J. (compiler). 1989. Quaternary geology of the Canadian Cordillera: Chapter 1 in: Quaternery geology of Canada and Greenland. R.J. Fulton (ed.). Geological Survey of Canada. Number 1.

Craighead, J.J., F.C. Craighead, and H.E. McCutchen. 1970. Age determination of grizzly bears from fourth premolar tooth sections. Journal of Wildlife Management 34(2):353-363.

Demarchi, D.A., R.D. Marsh, A.P. Harcombe, and E.C. Lea. 1990. The Environment (of British Columbia). Pages 55-142 in R.W. Campbell, N.K. Dawe, I. McTaggart-Cowan, J.M. Cooper, G.W. Kaiser, and M.C.E. McNall. The Birds of British Columbia. Volume 1. Royal B.C. Museum. Victoria, B.C.

Demarchi, M.W., S.R. Johnson and G.F. Searing. Incidental Grizzly Bear, *Ursus arctos*, sightings during autumn Mountain Goat, *Oreamnos americanus*, surveys in Westcentral British Columbia. Canadian Field-Naturalist 114(4):656-660

Duff, Wilson. 1964. The Indian history of British Columbia. Re-published in 1997 by the Royal B.C. Museum, Victoria. 184p.

Eberhardt, L.L. 1990. Survival rates required to sustain bear populations. Journal of Wildlife Management 54(4):587-590.

Ferguson, A., M. McPhee, B. Janowich and H. Utzig. 2002. Forest access and terrestrial ecosystems. Unpublished report prepared for Biodiversity Branch, Water Land and Air Protection. 103p.

Fladmark, K.R. 1986. British Columbia Pre-History. National Museums of Canada, Ottawa. ISBN: 0-660-10760-0. 150p.

Forbes, R. 1979. Grizzly Bear report – Toba watershed – Census and Status – 1979. Fish and Wildlife Branch. Surrey. 4p.

Fuhr, B. 1987. Hart Range Grizzly Project population estimates. Wildlife Branch. Ministry of Environment and Parks. Victoria. 23p.

Fuhr, B. and D.A. Demarchi. 1990. A methodology for Grizzly Bear habitat assessment in British Columbia. Wildlife Bulletin No. B-67. Ministry of Environment. Victoria. 28p.

GBSAC. 1997. Discussion Paper on Grizzly Bear Population Units and Grizzly Bear Management Areas. Submitted to Wildlife Branch, Ministry of Environment, Lands and Parks. Grizzly Bear Scientific Advisory Committee. Victoria. 9p.

GBSAC. 1998. Letter and attached report from Chris Servheen and Bruce McLellan. Grizzly Bear harvest limits. Submitted to Wildlife Branch, Ministry of Environment, Lands and Parks. Grizzly Bear Scientific Advisory Committee. Victoria.

Hallowell, A.I. 1926. Bear ceremonialism in the Northern Hemisphere. American Anthropologist, 28: 1-175.

Hamer, J.D.W. 1974. Distribution, abundance and management implications of the Grizzly Bear and Mountain Caribou in the Mountain Creek watershed of Glacier National Park, British Columbia. Master's Thesis. University of Calgary, Alberta. 164p.

Hamilton, A.N. 1991. Grizzy Bear capability estimates – Skeena region. Letter/report to Alan Edie, Regional Wildlife Biologist, Smithers, B.C. Fish and Wildlife Branch, Victoria.

Harris, R.B. 1986. Modeling sustainable harvest rates for grizzly bears. Unpublished manuscript. 17pp.

Harper, F. 1971. Regional Wildlife Biologist. Letter and report: Grizzly bears and your letter of January 4th, 1971. B.C. Fish and Wildlife Branch.

Harvey, R.G. 1998. Carving the western path: By river, rail and road through B.C.'s Southern Mountains. Heritage House, Surrey B.C. 240p.

Hatter, J., D.J. Robinson, P.W. Martin, L.G. Sugden, E.W. Taylor and W.G. Smith. 1956. Inventory and evaluation of wildlife resources of B.C. Transactions of the 8th B.C. Natural Resources Conference.

Hatter, J. 1963. Inventory and evaluation of wildlife resources of B.C. Transactions of the 15th B.C. Natural Resources Conference.

Hebda, R.J. 1996. Quaternary plants: glimpses of past climates and landscapes. Chapter 23 in: R. Ludvisgsen, Editor, Life in Stone: A natural history of British Columbia's fossils. UBC Press, Vancouver.

Hilderbrand, G.V., C.C. Schwartz, C.T. Robbins, M.E. Jacoby, T.A. Hanley, S.M. Arthur and C. Servheen. 1999. The importance of meat, particularly salmon, to body size, population productivity, and conservation of North American brown bears. Canadian Journal of Zoology: 77: 132-138

Hovey, F.W., and B.N. McLellan. 1996. Estimating population growth of grizzly bears in the Flathead River drainage using computer simulations of reproductive and survival rates. Canadian Journal of Zoology 74:1409-1416.

Harris, R.B. and L.H. Metzgar. 1987. Harvest age structures as indicators of decline in small populations of grizzly bears. International Conference on Bear Research and Management 7:109-116.

Hopwood, V.G. 1971. Editor. David Thompson: Travels in Western North America 1784-1812. Macmillan of Canada, Toronto. 342 p.

Klein, D.R. 1959. Track differentiation for censusing bear populations. Journal of Wildlife Mangement. 23(3):361-363

Krajina, V.J. 1965. Biogeoclimatic zones and classification of British Columbia. Ecology of Western North America. 1:1-17.

Lamb, W. K. 1960. Editor. Simon Fraser Letters and Journals, 1806-1808. Macmillan of Canada Limted. 292 p.

Lamb, W.K. 1970. The journals and letters of Sir Alexander Mackenzie. Hakluyt Society. Extra Series Number 41. Macmillan of Canada Ltd. 551 p.

Lamb, W.K. 1984. Editor. The voyage of George Vancouver 1791-1795: a voyage of discovery to the North Pacific Ocean and round the world. Hakluyt Society. Volume III: pages 787-1230.

Leonard, J., R.K. Wayne, and A. Cooper. 2000. Population genetics of ice age bears. Proceedings of the National Academy of Sciences, USA. 97(4): 1651-1654

Lloyd, K.A. 1975. Hunters, harvest, and management of grizzly bear in the Kootenay Region of British Columbia. Undergraduate Thesis (Honours Zoology), UBC. 92pp.

Mace, R.D., J.S. Waller, T.L. Manley, K. Ake and W.T. Wittinger. 1999. Landscape evaluation of Grizzly Bear habitat in Western Montana. Conservation Biology 13(2):367-377

MacHutchon, A.G., S. Himmer and C.A. Bryden. 1993. Khutzeymateen Valley Grizzly bear study. Final report. Wildlife Report Number R-25, Wildlife Habitat Research Report Number 31. B.C. Ministries of Environment, Lands and Parks and Forests. Victoria. 105 p.

McLellan, B.N. 1989. Effects of resource extraction industries on behaviour and population dynamics of grizzly bears in the Flathead drainage, British Columbia and Montana. PhD. Thesis. University of British Columbia. Vancouver. 116p.

McLellan, B.N. 1994. Density-dependent population regulation in brown bears. Pages 15-24 *in* M. Taylor, ed. Density-dependent population regulation in black, brown, and polar bears. International Conference on Bear Research and Management Monograph Series No. 3. 43pp.

McLellan, B.N. 1998. Maintaining viability of Brown Bears along the southern fringe of their distribution. Ursus 10:607-611.

McLellan, B.N. and F.W. Hovey, R.D. Mace, J.G. Woods, D.W. Carney, M.L. Gibeau, W.L. Wakkinen and W.F. Kasworm. 1999. Rates and causes of grizzly bear mortality in the interior mountains of British Columbia, Alberta, Montana, Washington, and Idaho. Journal of Wildlife Management 63(3):911-920.

Meilleur, Helen. 1980. A pour of rain: Stories from a west coast fort. Sono Nis Press. Victoria, B.C. 270p.

Meidinger, D.V. and J. Pojar, Eds. 1991. Ecosystems of British Columbia. Special Report Series Number 6. B.C. Ministry of Forests. Victoria. 330p.

Miller, S.D. 1990. Population management of bears in North America. International Conference on Bear Research and Management 8:357-373.

Ministry of Environment, Lands and Parks. 1996. Wildlife harvest strategy: improving British Columbia's wildlife harvest regulations. Ministry of Environment, Lands and Parks, Victoria, Brititsh Columbia, Canada. 73pp.

Mowat, G. and C. Strobeck. 2000. Estimating population size of Grizzly Bears using hair capture, DNA profiling, and mark-recapture analysis. J. Wildl. Manage. 64(1):183-193

G. Mowat, K.G. Poole, D.R. Seip, D.C. Heard, R. Smith and D.W. Paetkau. 2002. Grizzly and Black Bear densities in interior British Columbia. Aurora Wildlife Research. 35 p.

Mundy, K.R.D. and D.R. Flook. 1973. Background for managing grizzly bears in the national parks of Canada. Canadian Wildlife Service Report Series. Number 22. Environment Canada Wildlife Service. Ottawa35p.

Mustoe, G.E. and C.A. Carlstad. 1995. A Late Pleistocene brown bear (Ursus arctos) from Northwest Washington. Northwest Science 69(2):106-113

Nagorsen, D.W., G. Keddie and R.J. Hebda. 1995. Early Holocene Black Bears, *Ursus americanus*, from Vancouver Island. The Canadian Field Naturalist. 109:11-18

Patkeau, D.H., L.P. Waits, P. Waser, L. Clarkson, L. Craighead, E. Vyse, R. Ward, and C. Strobeck. 1998. Variation in genetic diversity across the range of North American brown bears. Conservation Biology. 12:418-429

Pearson, A.M. 1975. The Northern Interior Grizzly Bear *Ursus arctos* L. Canadian Wildlife Service. Report Series Number 34. 86 p.

Petticrew, P.S. and W.T. Munro. 1979. Preliminary Grizzly Bear management plan for British Columbia. Fish and Wildlife Branch. Ministry of Environment. Victoria. 25p.

Pielou, E.C. 1991. After the ice age: the return of life to Glaciated North America. University of Chicago Press, Chicago. 366p.

Pojar, J., K. Klinka, and D.V. Meidinger. 1987. Biogeoclimatic ecosystem classification in British Columbia. Forest Ecology and Management 22:119-154.

Proctor, M.F., B.N. McLellan, and C. Strobeck. 2002. Population fragmentation of grizzly bears in Southeastern British Columbia, Canada. Ursus 12:*-*

Raine, M.R. and R.N. Riddell. 1991. Grizzly Bear research in Yoho and Kootenay National Parks 1988-1990. Final Report. Beak Associates Consulting Ltd., Calgary, Alberta.

RIC. 1998. Inventory methods for Bears. Standards for Components of British Columbia's Biodiversity. Number 21. Resources Inventory Branch, Ministry of Environment, Lands and Parks. Victoria. 68p.

Ross, P. Ian. 2002. Update COSEWIC Status Report on Grizzly Bear, l'Ours Grizzly (*Ursus arctos*). Draft. Submitted September 3rd, 2002. 118p.

Rushton, Gerald D. 1978. Whistle up the inlet. Douglas and McIntyre. Vancouver, B.C. 236 p.

Shepard, P. and B. Sanders. 1985. The Sacred Paw: The bear in nature, myth and literature. Viking Penquin, Inc. New York.

Simpson, K., K.B. Hebert and G.P. Woods. 1985. Habitats and management of the Grizzly Bear (*Ursus arctos L.*) in the Columbia Mountains of British Columbia. B.C. Fish and Wildlife Branch, Nelson, B.C. 48 p.

Spalding, D.J., B. Gates, W. McKay and K. Mundy. 1972. Management plan for British Columbia's Grizzly bears. Submitted by the Carnivore Committee. B.C. Fish and Wildlife Branch. 20p.

Spalding, D.J. 1992. The history of Elk (*Cervus elaphus*) in British Columbia. Contributions to Natural Science. Royal British Columbia Museum. Number 18. 24p.

Stoneberg, R.P., and C.J. Jonkel. 1966. Age determination in black bears by cementum layers. Journal of Wildlife Management 30:411-414.

Storer, T.I. and L.P. Tevis Jr. 1955. California grizzly. University of California Press. Berkley and Los Angeles. 335p.

Strom, K.B., M. Proctor and J. Boulanger. 1999. Grizzly Bear population survey in the Central Purcell Mountains, British Columbia. Axys Environmental Consulting Ltd. Calgary, Alberta.

Talbot, S.L. and G.F. Shields. 1996. An ice age refugium for large mammals in the Alexander Archipelago, Southeastern Alaska. Quaternary Research. 46:186-192

Teit, James Alexander. 1900. The Thompson Indians of British Columbia. Edited by Franz Boas. The Jessup North Pacific Expedition. Volume 1, Part IV. Nicola Valley Museum Archives Association. Merrit, B.C. ISBN: 0-920-755-02-X

Tompa, F. 1977. Grizzly management plan. Final draft. Fish and Wildlife Branch, Victoria. 33p.

Tompa. F. 1984a. Grizzly bears in British Columbia – harvest must be reduced. Pages 114-122 in: Western Proceedings – 64th Annual Conference of the Western Association of Fish and Wildlife Agencies. Victoria, July 16-19, 1984.

Tompa, F. 1984b. Grizzly bear harvest strategy. Part One. Discussion Paper. B.C. Fish and Wildlife Branch.

Tompa, F. 1984c. Carnivore / Problem Wildlife Management Specialist. B.C. Fish and Wildlife Branch, Victoria. Letter to Richard Harris, October 24th, 1984.

Turner, N.J. 1999. Time to burn: traditional use of fire to enhance resource production by Aboriginal Peoples in British Columbia. Pp. 185-218 in Robert Boyd (ed.) Indians, fire and the land in the Pacific Northwest. Covallis, OR, Oregon State University Press.

Van Drimmelen, B. 1985. Grizzly bear management plan for Skeena region. Ministry of Environment, Fish and Wildlife, Skeena Region, Smithers, B.C. 20p.

Voller, J. and S. Harrison (eds.) 1998. Conservation biology principles for forested landscapes. B.C. Ministry of Forests. UBC Press. 243 p.

Waits, L.P., S.L. Talbot, R.H. Ward, and G.F. Shields. 1998. Mitochondrial DNA phylogeography of the North American Brown Bear and implications for conservation. Conservation Biology 12(2): 408-417

Wielgus, R.B., F.L. Bunnell, W.L. Wakkinen and P.E. Zager. 1994. Population dynamics of Selkirk Mountain Grizzly Bears. J. Wildl. Manage. 58(2):266-272

Wolliams, Nina G. 1979. Cattle ranch: The story of the Douglas Lake Cattle Company. Douglas and McIntyre. Vancouver. 264p.

Woodcock, George. 1990. B.C. – A history of the province. Douglas and McIntyre. Vancouver and Toronto. 288p.

Appendix 1.

This Procedure Replaces:

None

Staff, Organizations Directly Affected:

Wildlife Management Staff

Policy Cross-references:

Ministry Policy Manuals, Volume 4, Section 7:
Subsection 01.01 Allowable Harvest
Subsection 01.07 Wildlife Harvest
Subsection 13.01 Goal of Wildlife Management

Other Cross-references:

British Columbia Grizzly Bear Conservation Strategy, Ministry of Environment, Lands and Parks, June 1995
Wildlife Harvest Strategy, Ministry of Environment, Lands and Parks, April 1996
Ministry Procedure Manuals, Volume 4, Section 7:
Subsection 01.01.1 Allowable Harvest
Subsection 01.03.1 Allocation of Hunting Opportunities

Purpose:

To identify the procedures and standards to be followed when managing grizzly bear harvest.

Definitions:

"Allowable Harvest" - means the total harvest that is allowed within an allocation period.

"Chief of Wildlife" - means the Chief of Wildlife, Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria.

Definitions Cont':

"Deputy Director" - means the Deputy Director of the Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria.

"Director" - means the Director, Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria.

"Control Kills" - means grizzly bears killed by Conservation Officers or anyone else as a result of bear human conflicts or interactions.

"Grizzly Bear Population Units" (GBPUs) - means identified areas that define individual grizzly bear populations for the purposes of management and conservation.

"Harvest" - means grizzly bears taken under resident Limited Entry Hunting, non-resident quota, and allocation to First Nations.

"Known Human Caused Mortality" - means the total of all grizzly bears killed by humans or as a result of human interaction that are known by wildlife management staff and that are recorded in a provincial database.

"Large Carnivore Research Biologist" - means the wildlife biologist in the Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria, responsible for the provincial coordination of grizzly bear research.

"Large Carnivore Specialist" - means the wildlife biologist in the Wildlife Branch, Ministry of Environment, Lands and Parks, Victoria, responsible for the provincial coordination of grizzly bear harvest management.

"Maximum Allowable Known Human Caused Mortality" - means the: maximum allowable total human caused mortality of grizzly bears, minus, an estimate of unknown human caused mortality.

"Maximum Allowable Total Human Caused Mortality" - means the maximum number of total human caused mortalities of grizzly bears allowed within a given GBPU, and includes known mortalities plus an estimate of unknown human caused mortalities.

"Regional Fish & Wildlife Manager" - means a regional manager of the Fish, Wildlife and Habitat programs in the Ministry of Environment, Lands and Parks.

"Regional Wildlife Section Head" - means a wildlife biologist section head in the regional Fish, Wildlife and Habitat programs in the Ministry of Environment, Lands and Parks.

"Total Human Caused Mortality" - means all known, and an estimate of unknown, grizzly bear deaths that can be attributed to human causes, either intended or accidental, including but not limited to: shooting, poisoning, striking with a vehicle, snaring or trapping, capture and handling, attack by domestic animals, and internal injury resulting from the consumption of artificial materials.

"Translocations" - means grizzly bears removed live from a GBPU, and released in a different GBPU.

"Unknown Human Caused Mortality" - means the human caused mortalities of grizzly bears that are not known by wildlife management staff and that are not recorded in a provincial database.

Procedures:

1 Principles

1.1 Total human caused mortality of grizzly bear populations will be sustainable, and will not reduce the viability or distribution of populations.

1.2 Population estimates, maximum allowable total human caused mortality, and harvests will be consistent with available scientifically supportable information, and will be conservative in recognition of uncertainty.

1.3 Harvests will be planned with the intent that total human caused mortality will not exceed the maximum allowable.

1.4 GBPUs designated as "Threatened" will be closed to grizzly bear hunting until they have recovered. Measures for recovery will be determined through Recovery Plans prepared for each Threatened GBPU.

1.5 GBPUs that are not connected to other GBPU's, and that have population estimates of less than 100 grizzly bears, will not be harvested due to their inherent vulnerability.Process

1.6 Wildlife Branch staff coordinate development of policy, procedure and standards with regions; remain current with and communicate advances in science; provide technical advice to regions; ensure that methods used for items such as population estimates and harvests are applied consistently across regions; and ensure that regulations are within the bounds of provincial legislation, policy and standards prior to recommending these to the Minister.

1.7 Regional Wildlife Section Heads (RWSHs) determine Grizzly Bear Population Units (GBPUs), population estimates consistent with the provincial model, maximum allowable human caused mortality, and allowable harvests. RWSHs will consult with the Large Carnivore Specialist (LCS) and Large Carnivore Research Biologist (LCRB).

1.8 RWSHs must forward recommendations for items in 2.2 above, along with the comments of the LCS and LCRB, to the Regional Fish and Wildlife Manager, for approval and submission to Victoria.

1.9 Due dates for all steps in the grizzly bear management and hunting regulations processes will be set annually by the Director or Deputy Director.

1.10 The Regional Fish & Wildlife Manager and the Chief of Wildlife will resolve issues forwarded by the biologists. Where appropriate, some regulation issues may go to the Deputy Director instead of the Chief of Wildlife. Unresolved issues will be referred to the Director of Wildlife for resolution with the Regional Director.

2 Population Estimates

2.1 Population estimates will be prepared for each GBPU. GBPUs will normally be composed of adjacent Management Units (MUs) that collectively make up a reasonably distinct population. It is recommended that partial MUs not be used, except where required for an ecologically valid GBPU. It is recommended that Limited Entry Hunt (LEH) zones be created where an MU is split between two or more GBPUs. GBPUs may be revised as needed to incorporate new information or changing distribution of adult female bears.

2.2 Grizzly bear habitat in areas >100 km^2 that are permanently closed to hunting, and that are intended to approximate natural ecosystems or populations, will not be used to determine population estimates for harvest management purposes. Examples of such areas include those Provincial Protected Areas that are permanently closed to hunting, and National Parks.

2.3 The LCRB is responsible for preparing provincial habitat capability estimates in cooperation with RWSHs and Resource Inventory staff. Habitat capability estimates will normally be revised every three years, except when revisions are needed to incorporate new scientifically valid information.

2.4 RWSHs will use provincial habitat capability estimates in combination with the provincial step-down process to determine population estimates for each GBPU. It is recommended that the step-down be done by variant within MU where possible. It is recognized that this may not be practical everywhere.

2.5 Population estimates will include all ages of grizzly bears. Population estimates will normally be updated every three years, but may be updated more often if needed to incorporate new scientifically valid information.

2.6 Population estimates based on habitat capability will be conservative, which will be defined as the low value of the density range within each provincial standard habitat capability class.

2.7 RWSH may use densities above the low value of the habitat capability class when justified by written rationale. LCRB must be consulted to ensure that densities are within the provincial

model. Population densities within a habitat class will always be within the density range assigned to that class.

2.8 Habitats can be reclassified to a different class where justified by scientific information by agreement of the RWSHs with the LCRB.

2.9 Where scientifically valid inventory information specific to an area is available, that information may be used to refine or replace the habitat based estimate. For the purpose of harvest calculatio..s the population estimate derived from direct inventories will normally be the population estimate minus the standard deviation of the estimate. Population estimates based on techniques that do not allow for the calculation of precision will be evaluated on a case by case basis. Estimates from population inventories will not be used when ministry inventory standards or assumptions of the inventory have been violated. The results from inventories may also not be used where the precision of the estimate derived is unreasonably low

2.10 Regional Fish & Wildlife Managers may implement new population estimates at the time they consider most appropriate in relation to current allocation periods. Where new information shows that past total human caused mortaiities are above the maximums allowable, these will be handled following the provisions for excess mortality in this procedure.

2.11 Valid inventory data will be used to improve the accuracy of the provincial habitat based model of estimating population size.

3 Harvest

3.1 RWSHs will provide the proposed allowable harvest, including quotas for information purposes, and the recommended LEH authorizations, for each GBPU, to the LCS. Regions having both fall and spring grizzly seasons may combine the proposed LEH and quotas for each season into one submission.

3.2 Harvests will be determined as follows:
allowable harvest = (maximum allowable total human caused mortality) - (estimate of unknown human caused mortality) - (the estimated known non-hunting human caused mortalities that are predicted to occur based on past experience).

3.3 All grizzly bear harvest submissions must use the standard provincial spreadsheet.

3.4 Total human-caused mortality for all GBPUs will be reviewed annually, and adjustments made in allowable harvests where required to stay within the maximum allowable total human caused mortality over the whole allocation period.

3.5 Normally, hunting seasons will be closed only where more than two years of '0' harvest would be needed to bring total mortality within the maximum allowable. Where two or less years of closure would be needed, seasons will normally be left open with the minimum legal harvest for either one or two years.

3.6 It is essential to avoid excess concentration of harvest, and therefore mortality (total and of females) will be monitored by LEH Zone. Harvests may be re-distributed between zones, possibly including closure of zones, to avoid excess concentration of either total or female harvest.

3.7 First Nations may be allocated grizzly bear harvest. All grizzly bears harvested by First Nations under their allocation are considered as part of the harvest. Any bears taken outside of a formal allocation will be considered as part of the known non-hunting human caused mortality.

4 Total Human-Caused Mortality

4.1 Total human caused mortality will be managed by GBPU.

4.2 The predicted total human caused mortality will not exceed the following maximums based on average habitat capability.

Average Habitat Capability*	**Maximum Allowable Total Human-Caused Mortality**
1	6%
2	6%
3	5%
4	4%
5	3%

* Calculated as the average habitat capability for contributing grizzly bear habitat within an MU.

4.3 Regions will estimate an unknown mortality rate, which will be included as part of the maximum allowable total human caused mortality for each GBPU. Unknown rates will normally be 2% in areas having high human grizzly interactions. Rates will be lower in areas having fewer such interactions, but will not be below 1% unless supported by a written rationale.

4.4 Total human caused mortality of grizzly bears (both total bears and females) will be managed over fixed multi-year periods corresponding to harvest allocation periods. The preference is for three year allocation periods. Periods up to 5 years may be used where warranted.

4.5 Wherever total human caused mortality exceeds the maximum for a given allocation period, the overkill (either total or of females) will be carried forward to the next allocation period and deducted from the maximum allowable total human caused mortality for that period.

4.6 Known human caused mortality of female grizzly bears within each GBPU must not exceed 30% of the maximum allowable known human caused mortality for the GBPU over an allocation period.

4.7 Grizzly bear translocations will be counted as if they were known mortalities in the source GBPU. Translocated bears will not be added to the population estimate used for harvest purposes of the area of relocation, however, if they die as a result of human causes they will not be counted as a mortality in the new area.

5 Population Objectives

5.1 Regional Fish and Wildlife Managers have discretion to prepare and recommend objectives for grizzly bear populations for GBPUs. Objectives will be for specific population numbers, recognizing that there is always uncertainty concerning populations. Objectives may be higher, lower, or equal to the current population estimate. It is not mandatory to prepare objectives. In the absence of approved objectives, grizzly bear populations cannot be managed to reduce numbers. All objectives must provide for a grizzly population that is viable over the long term.

5.2 The Director of the Wildlife Branch approves population objectives based on recommendations from the Regional Fish and Wildlife Manager and the Chief of Wildlife.

5.3 Population objectives must be justified by a written rationale that includes: a conservation assessment including threats to the population, assessment of population trends, current population estimate, current habitat capability, and results of stakeholder consultations. Consultations with non-hunting and hunting stakeholders are required. Total human caused mortality of grizzly bears will be managed to facilitate meeting the objective for each GBPU over time.

5.4 Objectives lower than current population estimates would normally only apply in areas where there is documentation of chronic high levels of grizzly bear - human conflicts, and where the problems are shown to be linked to grizzly population size rather than other factors such as poor management of attractants. Such objectives should normally only apply where there is high public demand to reduce grizzly populations.

5.5 Where approved objectives are lower than the current population estimate, regions may deduct control kills and translocations from the population estimate for the GBPU, instead of incorporating them as part of the maximum allowable human caused mortality. No other human caused mortalities may be deducted from the population estimate. All control kills and translocations will be accounted for in either human caused mortality or population reductions.

Appendix 2.

A Guide to the British Columbia Wildlife Branch Spreadsheet for Calculating Allowable Grizzly Bear Harvest

Introduction

As the dramatic reduction in the range of grizzly bears in North America over the last 200 years illustrates, this species is extremely sensitive to excessive human caused mortality. As a result of this, as well as their sensitivity to human disturbance and habitat loss, grizzly bears are listed as Vulnerable nationally in Canada and are Blue-listed provincially in British Columbia.

In response to growing concern about grizzly bears and the habitats they depend on the provincial government launched the Grizzly Bear Conservation Strategy (GBCS) in June, 1995. The GBCS recognizes both the importance of hunting to many British Columbians and the fact that issue of future of grizzly bear hunting has been, and continues to be, a polarized debate.

In order to improve the management of grizzly bear hunting the GBCS has placed the entire province on Limited Entry Hunting (LEH) and includes key commitments to increase habitat and population research and inventory in order to improve population estimates, to map ecologically based areas to serve as the foundation for grizzly bear conservation and management, to conduct ongoing reviews of hunting regulations and to update these regulations and related allocations or quotas as necessary to ensure that grizzly bear populations are conserved.

In addition to the GBCS the other policy document with relevance to grizzly bear harvest is the Wildlife Harvest Strategy (WHS) which was released in April, 1996. The WHS states that harvest must not impair the sustainability of any hunted species, that harvest prescriptions must be based on scientific principles, that these prescriptions must also be sufficiently conservative to allow for uncertainty in population estimates and that the harvests of Blue-listed species and subspecies will be particularly cautious to ensure conservation. Specifically with respect to grizzly bears the WHS states that "the conservation of grizzly bears and their habitats will supersede all other activities related to harvest management" and "Grizzly bears will be harvested only where hunting will not jeopardize population sustainability."

Finally, in addition to the GBCS and WHS, the Grizzly Bear Harvest Procedure was approved in October, 1999 and outlines specifically how grizzly bear harvests are to be administered. The British Columbia Wildlife Branch Spreadsheet for Calculating Allowable Grizzly Bear Harvest has been prepared to facilitate the calculations necessary to comply with this procedure as well as to serve as the form for submitting Annual Allowable Harvests and recommendations for Limited Entry Hunting seasons to the Wildlife Branch for review.

This guide is intended to provide a detailed explanation of the spreadsheet for those that are either completing the form or seeking to better understand the process used to determine allowable harvest levels.

Overview of the Process

The process of determining sustainable harvest levels for grizzly bears begins with the development of a population estimate for the LEH Zone(s) and Grizzly Bear Population Unit (GBPU) in question. GBPUs are groupings of LEH Zones that constitute a reasonably distinct population or sub-population of grizzly bears and serve as the foundation for grizzly bear conservation and management.

Population estimates are derived either directly from scientifically valid population inventories or indirectly through the Fuhr-Demarchi method. This method involves two basic steps. The first is to apply grizzly bear population densities based on research and inventory work in similar areas in the province to various habitat types to calculate the habitat capability of a given area such as an LEH Zone. The habitat capability is the estimated number of grizzly bears that this area could support under ideal conditions. The second step in the process is to "step-down" the habitat capability to arrive at the actual population estimate by incorporating the impacts of habitat loss, habitat alteration, habitat fragmentation, habitat displacement and historic human caused mortality.

Regardless of the method that is used to develop grizzly bear population estimates the common principle is that these estimates must be conservative in order to guard against overestimates that might result in artificially high allowable human caused mortality levels. As a result managers will seek to ensure that any error in grizzly bear population estimates will be on the side of conservation.

Once a population estimate has been prepared the maximum annual allowable total human caused mortality rate is determined. This is based on a sliding scale between 3 and 6% and is linked directly to the average habitat capability of the LEH Zone. The higher the average habitat capability, the higher the productivity of the area is assumed to be and therefore the higher the rate of human mortality that the population is capable of sustaining. This rate is for all human caused mortality, however, some human caused mortality is not known by wildlife managers (e.g. undetected poaching, crippling loss during legal hunting, unreported road and train kills or grizzly-bear human conflicts, etc.).

In order to address the issue of unknown human caused mortality, an estimate of the annual rate of loss to these unknown human causes is deducted from the total allowable human caused mortality to arrive at the maximum annual known human caused mortality rate. This rate is then multiplied against the population estimate to determine the actual number of grizzly bears that can be lost to all known human causes (hunting and non-hunting) in any given year. Note that translocations of grizzly bears outside of a GBPU are treated as mortalities since these animals are effectively lost from these populations. In some areas with a history of known non-hunting human caused mortality (e.g. grizzly bear-human conflicts) an estimate of the rate of loss from this source can also be made and incorporated later in the process. This estimate will usually be based on an average of the actual annual mortalities from this source.

Before the harvest available in the current allocation period can be determined an analysis of the known human caused mortality for the previous allocation period must be conducted to determine whether there was an overkill of either total grizzly bears or females. This is done by simply deducting the actual known human caused total and female mortality from the allowable levels. Any negative balances are carried forward and deducted from what would otherwise be available during the current allocation period. Note that overkills will not normally be carried forward unless they have occurred for the GBPU as a whole and that only the net overkill for the GBPU should be carried forward.

Allowable female mortality is calculated and tracked separately because limiting human caused female mortality is critical to the long-term viability of grizzly bear populations. The maximum level specifically for known human caused female mortality is set at 30% of the level for all grizzly bears.

The calculation of the known human caused mortality balance that is available for harvest during the current allocation period follows the same general process as described for the previous allocation period. One exception is that if an estimate of known non-hunting human caused mortality has been made, this annual rate is multiplied by the length of the allocation period (usually 3 years) and that value in turn is multiplied against the population estimate of the LEH Zone to determine the estimated number of grizzly bears that will be lost to these non-hunting human causes during the current allocation period. This estimate is deducted from the maximum allowable known human caused mortality for the current allocation period to arrive at the maximum allowable harvest.

The advantage of including an estimate of known non-hunting human caused mortality for areas where such losses are likely to occur is that it avoids the risk that the occurrence of these mortalities will force managers to restrict hunting opportunities and thereby impact allocations during the allocation period in order to avoid exceeding the maximum allowable known human caused mortality level. If known non-hunting human caused mortalities are lower than estimated, increased hunting opportunities could be provided toward the end of the allocation period.

Once allowable harvest balance and known human caused female mortality balance for the current allocation period have been calculated it is necessary to examine the unused allocations for non-residents and First Nations in order to determine what portion of the harvest balance is available for residents. This involves deducting the unused portion of any allocations to non-residents and First Nations from the harvest balance to arrive at the allowable harvest balance available for residents for the current allocation period. A portion of this balance is then allocated to the specific hunting season in question based primarily on the remaining number of hunting seasons (e.g. if there are two hunting seasons remaining during the current allocation period the resident allocation for the next season might be half of the allowable harvest balance for residents).

Once the desired harvest by residents for the hunting season in question has been determined the number of LEH authorizations must be calculated. Since only a fraction of resident hunters that

are drawn to hunt grizzly bears are successful, the desired resident harvest is divided by the proportion of hunters that are successful in the specific area in question. In order to minimize the risk of a dramatic change in success rates unduly impacting mortality levels, a minimum success rate of 10% has been set for LEH which means that no more than 10 LEH authorizations will be issued for each animal to be harvested (this is in despite of the fact that in some areas success rates are below 10%).

The last step in this process is for the wildlife managers involved to formally recommend the number of LEH authorizations that they believe should be issued. This number may vary considerably from the number calculated simply by dividing the desired resident harvest by the success rate due to professional opinion based on concerns over local concentration of mortality, female mortality levels etc.

This description is based on the assumption that the population objective for the GBPUs for which allowable mortality and harvest levels are being calculated, is to maintain the current population. It is also possible, however, for population objectives to be set that seek to increase a population or to allow it to decline to a lower level (although no population objective will be set that would allow a population to become threatened which is defined as <50% of habitat capability). When the objective is to allow the population to increase, the maximum annual allowable total human caused mortality rate may be set below the level that would otherwise be applied (e.g. 4% instead of 6%).

When the population objective for a GBPU allows for the population to decline, some or all mortality from known non-hunting human causes may be deducted from the population estimate and these would then not be counted toward the allowable mortality level for the GBPU. An objective that allows for a population decline will normally only be set for areas where there is a history of chronic high levels of grizzly bear-human conflicts and where it has been established that these conflicts are linked to size of the grizzly bear population as opposed to human factors such as poor management of attractants.

The process for calculating sustainable harvest rates for grizzly bears is complicated, however, the intention of the provincial government is to ensure that, through the application of this rigorous method including careful tracking of mortalities and a feedback loop to address any unintentional overkills, the long-term viability of grizzly bear populations in British Columbia will not impacted through recreational grizzly bear hunting.

Detailed Description by Section

Tracking Information

Row	Heading	Description
3	Date Completed:	The date that the spreadsheet was filled out (it is important that this be changed to reflect any subsequent drafts).
3	Completed By:	The name of the person(s) responsible for filling out the spreadsheet.
3	Hunting Season:	The hunting season that the spreadsheet applies to.

Population Information

Column	Heading	Description
A	LEH Zone	The number of the Limited Entry Hunting (LEH) Zone in question (e.g. 4-23A). Remember that some LEH Zones include portions of more than one WMU when compiling mortality data. It is also important to group LEH Zones by Grizzly Bear Population Units (GBPUs) and to include their names as well as the sums of the columns for each GBPU as a whole as shown in the example.
B	Pop. Est.	The population estimate for the LEH Zone (see the Grizzly Bear Harvest Management Procedure, Section 3, for details). Does not include any areas within the LEH Zone >100km^2 that are indefinitely closed to grizzly bear hunting.
C	Maximum Annual Allowable Total Human Caused Mortality	The estimated proportion of the population that can be sustainably be lost or taken by all human causes (known and unknown) each year (see the Grizzly Bear Harvest Management Procedure, Section 5.2, for details). Ranges from 0.03-0.06 based on the average habitat capability of the contributing grizzly bear habitat. **Note that "mortality" throughout this spreadsheet includes any animals translocated outside of the GBPU in question (see the Grizzly Bear Harvest Management Procedure, Section 5.7, for details).**
D	Estimated Annual Unknown Human Caused Mortality	The estimated proportion of the population that will be lost to human-caused mortality but that will not be reported to, and tracked by, the provincial government (e.g. poaching, crippling loss, unreported harvest by First Nations people, unreported road and train kills etc.) The estimate will be approximately 0.02 for areas with high grizzly bear-human interactions, estimates below 0.01 must be accompanied by a written rationale (see the Grizzly

Bear Harvest Management Procedure, Section 5.3, for details).

Column	Heading	Description
E	Estimated Average Annual Known Non-Hunting Human Caused Mortality	Filling out this column is voluntary. This estimate is the proportion of the population that is predicted to be lost annually as a result of known non-hunting human caused mortality (e.g. bear-human conflicts). By including an estimate for areas where such losses have traditionally occurred managers can reduce the likelihood that calculated harvest levels and allocations will be negatively impacted by these mortalities in the future (e.g. if allocations are based on the assumption that there will be no grizzly bears lost from these causes any actual losses will directly result in reduced hunting opportunities). A recommended strategy for areas with a history of mortalities from these non-hunting sources is to include an estimate at the beginning of an allocation period with the understanding that if this source of mortality is lower than predicted that additional harvest opportunities may be made available toward the end of the allocation period (e.g. in the last year).
F	Maximum Annual Allowable Known Human Caused Mortality (proportion)	This column is automatically calculated (Col. C - Col. D). It is the proportion of the population that can be lost or taken each year through known human caused mortality.
G	Maximum Annual Allowable Known Human Caused Mortality (number)	This column is automatically calculated (Col. B x Col. F). It is the number of grizzly bears from the population that can be lost or taken each year through known human caused mortality.

Previous Allocation Period

Column	Heading	Description
I	Maximum Allowable Known Human Caused Mortality for the Previous Allocation Period	This column is automatically calculated (Col. F x 3). Enter the dates covered by the previous allocation period at the bottom of the heading where it says "dates". Assumes a 3 year allocation period (alter the formula accordingly if this is not the case). In addition, you may need to enter these values directly if the allowable harvest for the previous allocation period was based on a different population estimate, incorporated any carried forward overkill or was based on a different allowable mortality rate.

Column	Heading	Description
J	Known Human Caused Mortality for the Previous Allocation Period	The total number of grizzly bears known to have been killed by all human causes (hunting and non-hunting including bear-human conflicts, known poaching etc.) during the previous allocation period. Note that this includes grizzly bears translocated out of the GBPU in question. The normal sources for this information would be the Summary Statistics Database and reports from Conservation Officers.
K	Known Human Caused Mortality Balance for the Previous Allocation Period	This column is automatically calculated (Col. I - Col. J). Any negative values are treated as overkills and are carried forward and deducted from the available harvest for the current allocation period.
L	Maximum Allowable Known Human Caused Female Mortality for the Previous Allocation Period	This column is automatically calculated (Col. I x 0.30). This value is based on the direction that known human caused female mortality should not exceed 30% of total known human caused mortality (see the Grizzly Bear Harvest Management Procedure, Section 5.6, for details).
M	Known Human Female Caused Mortality for the Previous Allocation Period	The total number of female grizzly bears known to have been killed by all human causes (hunting and non-hunting including bear-human conflicts, known poaching etc.) during the previous allocation period. Note that this includes grizzly bears translocated out of the GBPU in question. The normal sources for this information would be the Summary Statistics Database and reports from Conservation Officers.
N	Known Human Caused Female Mortality Balance for the Previous Allocation Period	This column is automatically calculated (Col. L - Col. M). Any negative values are treated as female overkills and are carried forward and deducted from the maximum allowable known female mortality for the current allocation period.

Current Allocation Period

Column	Heading	Description
P	Maximum Allowable Known Human Caused Mortality for the Current Allocation Period	This column is automatically calculated ((Col. G x 3) + Col. K if <0). Assumes a 3 year allocation period (alter the formula accordingly if this is not the case). Enter the dates covered by the previous allocation period at the bottom of the heading where it says "dates".

(cont.)

Column	Heading	Description
P (cont.)		Any overkill from the previous allocation period is carried forward and deducted from the current allocation period (see the Grizzly Bear Harvest Management Procedure, Section 5.5, for details). Please note that if there was not a net overkill for the GBPU as a whole, individual LEH Zone overkills are not carried forward. To carry forward a net overkill alter the LEH Zone formula by deducting the portion of the overkill assigned to that LEH Zone (see spreadsheet example). Also note that the GBPU formula varies from the LEH Zone formula.
Q	Estimated Known Non-Hunting Human Caused Mortality for the Current Allocation Period	This column is automatically calculated (Col. B x Col. E x 3). Assumes a 3 year allocation period (alter the formula accordingly if this is not the case). This estimate is the number of animals that are predicted to be lost during the allocation period as a result of known non-hunting human caused mortality (see Col. E for details).
R	Maximum Allowable Harvest for the Current Allocation Period	This column is automatically calculated (Col. P - Col. Q). The estimated known non-hunting human caused mortality is deducted from the maximum allowable known human caused mortality to avoid having harvest impacted by this source of mortality (see Col. E for details).
S	Known Hunting Mortality for the Current Allocation Period.	The total number of grizzly bears known to have been killed through legal grizzly bear hunting (including First Nations harvest) during the current allocation period. The normal source for this information would be the Summary Statistics Database.
T	Known Non-Hunting Human Caused Mortality for the Current Allocation Period	The total number of grizzly bears known to have been killed by all non-hunting human causes (including bear-human conflicts, known poaching etc.) during the current allocation period. Note that this includes grizzly bears translocated out of the GBPU. The normal sources for this information would be the Summary Statistics Database and reports from Conservation Officers.
U	Total Known Human Caused Mortality for the Current Allocation Period	This column is automatically calculated (Col. S + Col. T). By combining known hunting and non-hunting mortalities from the two previous columns this represents the total number of grizzly bears known to have been killed by all human causes during the previous allocation period. Note that this includes grizzly bears translocated out of the GBPU. The normal sources for this information would be the Summary Statistics Database and reports from Conservation Officers.

Column	Heading	Description

V	Allowable Harvest Balance for the Current Allocation Period	This column is automatically calculated ((Col. R - Col. S) - (Col. T - Col. Q if >0)). The harvest for the current allocation period is deducted from the allowable harvest and, if known non-hunting mortality exceeds the level estimated, the difference is also deducted. This leaves the number of bears that remain available for harvest during the current allocation period.
W	Maximum Allowable Known Human Caused Female Mortality for the Current Allocation Period	This column is automatically calculated ((Col. P x 0.30) - Col. N if <0). This value is based on the direction that known human caused female mortality should not exceed 30% of total known human caused mortality and that female overkills from the previous allocation period should be carried forward and deducted from the allowable female mortality for the current allocation period (see the Grizzly Bear Harvest Management Procedure, Section 5.5 and 5.6, for details). Please note that if there was not a net overkill of females for the GBPU as a whole, individual LEH Zone overkills are not carried forward. To carry forward a net female overkill alter the LEH Zone formula by deducting the portion of the overkill assigned to that LEH Zone (see spreadsheet example). Also note that the GBPU formula varies from the LEH Zone formula.
X	Known Human Female Caused Mortality for the Current Allocation Period	The total number of female grizzly bears known to have been killed by all human causes (hunting and non-hunting including bear-human conflicts, known poaching etc.) during the current allocation period. Note that this includes grizzly bears translocated out of the GBPU in question. The normal sources for this information would be the Summary Statistics Database and reports from Conservation Officers.
Y	Known Human Caused Female Mortality Balance for the Current Allocation Period	This column is automatically calculated (Col. W - Col. X). The actual known human caused female mortality is deducted from the allowable known human caused female mortality for the current allocation period leaving the "balance" or number of female bears that can still sustainably be lost to human causes of mortality during the current allocation period..

Harvest Allocations

Column	Heading	Description
AA	Non-Resident Allocation for the Current Allocation Period	The total allocation to non-resident harvest during the current allocation period (should be reflected directly in Guide Outfitter Quotas and administrative guidelines).
Column	Heading	Description
AB	Non-Resident	The legal non-resident harvest during the current allocation

	Harvest for the Current Allocation Period	period. Note that if the non-resident harvest exceeds the non-resident allocation that the formula for calculating the allowable harvest balance available for residents (Col. AE) must be altered to avoid having the negative value that will be generated when the non-resident harvest is deducted from the non-resident allocation artificially inflate the harvest balance for residents. In this situation the formula (Col. AE) should be changed to exclude any reference to the non-resident allocation and harvest.
AC	First Nations Allocation for the Current Allocation Period	The total allocation to First Nations harvest during the current allocation period (see the Grizzly Bear Harvest Management Procedure, Section 4.7 for details).
AD	First Nations Harvest for the Current Allocation Period	The legal First Nations harvest during the current allocation period. Any First Nations harvest that occurs outside an allocation should not be included in this column but should be accounted for under either Col. S or T (see the Grizzly Bear Harvest Management Procedure, Section 4.7 for details). Note that if the First Nations harvest exceeds the non-resident allocation that the formula for calculating the allowable harvest balance available for residents (Col. AE) must be altered to avoid having the negative value that will be generated when the First Nations harvest is deducted from the First Nations allocation artificially inflate the harvest balance for residents. In this situation the formula (Col. AE) should be changed to exclude any reference to the First Nations allocation and harvest.
AE	Allowable Harvest Balance Available for Residents for the Current Allocation Period	This column is automatically calculated (Col. V - (Col. AA - Col. AB) - (Col. AC - AD)). The unused portions of the allocations to non-residents and First Nations are deducted from the allowable harvest balance and the remaining balance is available for harvest by residents. Where either non-resident harvest exceeds the non-resident harvest or First Nations harvest exceeds First Nations allocation(s) this formula must be altered (see Col. AB and AD for details).

Column	Heading	Description
AF	Resident Allocation for this	The number of grizzly bears that will be made available for harvest by residents during the hunting season in question. The

	Season	total for the GBPU must be lower than the allowable harvest balance available for residents and should reflect a division based on the number of hunting seasons remaining in the allocation period.

LEH Authorizations

Column	Heading	Description
AH	Success Rate	The average proportion of hunters that obtain LEH authorizations for the LEH Zone in question that are successful in harvesting a grizzly bear. The average should be based on the actual success for at least the most recent 3 years that information is available for. The lower the success rate, the higher the number of authorizations that will be issued for each animal available for harvest by residents. The minimum success rate used for LEH is 0.10 (10%).
AI	Calculated Authorizations	This column is automatically calculated (Col. AF / Col. AH). The resident allocation for the season in question is divided by the success rate to calculate the number of authorizations that could be made available to residents.
AJ	Recommended Authorizations (Region)	The actual number of authorizations recommended for the LEH Zone by regional staff. The value may vary from the calculated number of authorizations due to concerns over female mortality, balancing mortality across the GBPU, concerns over locally concentrated mortality etc. Note that unless there are exceptional circumstances the recommendation should be within the range of authorizations (see Col. AM for details).
AK	Recommended Authorizations (Headquarters)	The actual number of authorizations recommended for the LEH Zone by headquarters staff. The value may vary from the calculated number of authorizations due to concerns over female mortality, balancing mortality across the GBPU, concerns over locally concentrated mortality etc. Where the regional and headquarters recommendations initially differ, technical staff should endeavor to resolve these differences as quickly as possible.

Column	Heading	Description
AL	Season Dates	The opening and closing dates for the hunting season in question.

AM	R.O.A.	The range of authorizations in the LEH Regulation for the LEH Zone in question. Any recommendation outside this range would require an Order in Council to alter the legally established range. The exception to this is a Minister's Order to close the hunting season altogether (see the Grizzly Bear Harvest Management Procedure, Section 4.5 for details).
AN	Notes	Any explanatory notes including concerns about total or female overkill.